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	PAGE		PAGE
<i>The National Physical Laboratory, New Delhi—Its Genesis, Scope and Function</i> ..	35	<i>Friedel-Crafts Polymerisation— S. L. KAPUR</i> ..	43
<i>Directory of Culture Collections of Micro- organisms Maintained in India</i> ..	38	<i>Advances in Microbiology</i> ..	44
<i>Papyrographic Studies in Nitrogen Meta- bolism of Micro-organisms. Part I. A. Critical Study of the One-Dimensional Micromethod of Papyrography for the Analysis of Protein Hydrolysates— V. S. GOVINDARAJAN AND M. SREENIVASAYA</i>	39	<i>Ship Propulsion by Wave Motion</i> ..	45
<i>Science and Commonsense</i> ..	42	<i>Physiology of Health and Physical Fitness—DR. K. P. MENON</i> ..	46
		<i>Problems and Prospects of Indian Anthro- pology</i> ..	46
		<i>Letters to the Editor</i> ..	47
		<i>Reviews</i> ..	69
		<i>Science Notes and News</i> ..	75

THE NATIONAL PHYSICAL LABORATORY, NEW DELHI

Its Genesis, Organisation, Scope and Function*

BY

SIR S. S. BHATNAGAR, F.R.S.

IN 1941, I made known to the Government that the combined physical and chemical laboratory of which I was then Director was wholly inadequate for meeting the needs of scientific developments in the new India and I placed my recommendations before the then Government for an early establishment of a National Chemical and a National Physical Laboratory. It took two years for that Government to accept the proposal; and when accepted the funds allotted for these laboratories were to be given spread over four or five years after

the War. Those who know what skill and patience is needed to get any grant from the Finance Department will well realise the difficulties through which we had to pass. Sir Jeremy Raisman was then Member-in-charge of Finance and I told him one day quite seriously that India will accuse him of doing everything possible to lose the War in the most economical manner if he did not help the movement for encouragement to Science in the country! While the attitude of the present National Government is certainly more helpful, it cannot be said that sufficiently large sums of money have been given by the Government to develop Indian Science to the stature to which she should rise if India is to play her legitimate

* From a speech delivered on 21-1-1950 on the occasion of the Opening Ceremony of the National Physical Laboratory.

role as an important free country in the world. The rumour that Scientific Research has suffered no cuts in the budget is incorrect. We had to suffer equally with the others.

It was only in 1945 that some funds were made available and a planning committee was appointed which prepared the initial plans. In preparing this plan, I and some members of the Planning Committee had the advantage of the experience which we gained when we visited U.K. and U.S.A. in 1944-45 as guests of the U.K. and the U.S.A. Governments respectively. We made a special study of the new designs and equipments in the U.S.A. in such laboratories, as the Bell Telephone Company's Laboratory, the R.C.A. Laboratory, the North-Western University Laboratories and the Carnegie Institute in Pittsburg, the M.I.T., the Caltech, the Mellon Research Institute and the four famous regional laboratories of the U.S.A. The plans were placed before Messrs. Master, Sathe & Bhuta, famous Bombay architects, who have also designed our National Chemical Laboratory which was recently opened at Poona by the Prime Minister, and these two buildings have enhanced their reputation as architects of skill and integrity in India.

The main features of the building are provision of air conditioning, flexibility which allows a change in the sizes of rooms in steps of six feet units at will, a long basement which serves as a store as well as a tunnel for protected services such as gas, steam, electricity and compressed air. These services lie vertically in every room in the Laboratory without winding themselves round the walls and corridors thus saving lakhs of rupees and providing means of introducing any new service lines which may be necessary without having to dig into the walls and floors of the rooms. We have a temporary workshop which is fairly good, but a splendid workshop is nearing completion and we have selected a Czechoslovakian expert to be in charge of it. We hope to be able to manufacture all kinds of instruments we need ourselves. We shall be glad to help advanced research workers in Universities and Governments by giving them the guidance of our experts and the use of our equipment for anything difficult which they cannot make themselves.

Our enlightened Council of Scientific and Industrial Research was alive to the need of a suitable Director as without such a man the buildings alone might degenerate into a body without a soul. India has distinguished herself in Physics and has provid-

ed a majority of Indian Fellows of the Royal Society and a Nobel Laureate. I was certain that we will not have to go out of the country to get an expert to guide the destinies of this Laboratory. We selected unanimously Dr. K. S. Krishnan, F.R.S., whose fame as a physicist transcends the limits of this country. In Indian physics the most sensational discovery for which Sir C. V. Raman was awarded the Nobel-Prize is the Raman Effect. As we all know our distinguished Director was most intimately associated with this discovery. He is a scholar of eminence and yet his genius does not originate in mental eccentricities; its poise and depth rest on the solid foundation of innate culture and a balance without which co-operative effort in research is an impossibility.

My pride is, that with the help of our Government and the people, I have succeeded in creating a ladder and in placing a sure-footed and tried leader on the first run. The first rung of a ladder is a place of resting for no one. It only holds a man's foot long enough to enable him to put the other somewhat higher and I have faith and confidence in our Director's ability to climb up higher and higher till India's National Physical Laboratory reaches that pinnacle of achievement which distinguishes our Himalayan peaks from the rest of the mountains of the world.

Dr. K. N. Mathur, Assistant Director and Officer-in-charge of Planning, has worked with extraordinary devotion. Every brick in this building claims familiarity with this devoted officer. Dr. Mathur combines in him the exactness of a physicist and the imagination of an artist. The country owes him a deep debt of gratitude for this noble building. We have been old collaborators in the field of magnetochemistry and I wish to congratulate him personally for the solid contribution he has made to the progress of science in this country.

The main functions of the Laboratory, namely, maintenance of fundamental and derived standards and Applied & Pure have been fully described before.

The work of the Laboratory will be carried in the following nine Divisions:—

- (i) Weights and Measures
- (ii) Applied Mechanics & Materials
- (iii) Heat and Power
- (iv) Optics
- (v) Electricity
- (vi) Electronics and Sound
- (vii) Building and Housing Research
- (viii) Hydraulic Research
- (ix) Analytical Chemistry.

Besides these nine Divisions in the original plan, a tenth Division on Industrial Physics has been added to the Laboratory. The National Physical Laboratory will give that stimulus to the development of industry which in the past appears to have been a prerogative of the subject of Chemistry. In fact Physics is proving so useful to Industry that it seems to have already caught up with Chemistry and if Engineering is to be classed as applied physics, I venture to say that it has already beaten Chemistry.

One aspect of fundamental research work which can hardly be neglected in India is that it requires specialised large-scale laboratories. During recent years, and particularly during the last world war, organisation of scientific work has undergone vast changes. Not only does some of the present type of work require large-scale specialised organisations well outside the scope of university work but also expenditure of large sums of money which could only be justified if diversified, co-ordinated and regulated application and professional continuity of work are guaranteed. This is not usually possible in the universities where teaching and research necessarily go hand in hand and are essentially preparatory. Research work there is bound to be scrappy, discontinuous and un-co-ordinated. I may be permitted to quote here from an article by Dr. Lee A. Dubridge who is now President of the California Institute of Technology and who during the War was Director of the Radiation Laboratory at Massachusetts Institute of Technology which had such a lot to do with the conduct of atomic energy development in the U.S.A. Discussing the importance of large research laboratories, Dr. Dubridge says "... it should be clear that independent laboratories will have as their major facilities only those very large installations which, as far as can be foreseen, are beyond what a single university could contemplate operating—or which, because of shortage of material or funds, not more than one or two universities in any area could have. So I, for one, look forward with keen interest to a great new experiment in physical research. Those who long for the old days with lone worker in the damp basement room with his wax and string and glass-blowing torch can have them. I believe that the essential spirit of the old days—freedom of enquiry and time for thought—can be obtained even in the pressure of great new physical and organisational techniques". It is a fact that fundamental research itself has now become a huge organised industry in itself.

Many problems of industry and even pure physics are such as require for their solution

the technique of more than one branch of physics and sometimes calls for team-work in all the branches. A collection of experts in the various divisions will make this team-work a possibility in this Laboratory. The first experience of the success of team-work in science was noticed during the War. Its application to industry and human progress has still greater possibilities. India's youngmen are full of enthusiasm for service and the National Laboratories provide a fertile field of work for them, provided their basic education has been sound and distinguished.

The Council of Scientific and Industrial Research has several endowments given to it by industry. The magnificent gifts of Rs. 11.70 lakhs for the National Metallurgical Laboratory and Rs. 8.30 lakhs for the National Chemical Laboratory from the Tata House, Bombay; Rs. 1 lakh from Sir Inder Singh of Indian Wire & Steel Products for the National Metallurgical Laboratory; Rs. 15 lakhs from Dr. Alagappa Chettiar; Rs. 15 lakhs from the Silk Industry and numerous other donations of land and money are indicative of a rising conviction amongst industrialists in India that they must help Science. The greatest achievement of which the Council of Scientific and Industrial Research and the Department of Scientific Research can be justly proud is that they have succeeded in creating enthusiasm amongst young Indian scientists for dedication of their lives to research and an awakening amongst industrialists that their work of service can be helped by science. At no time in the history of India was this enthusiasm so great as now and this can be directly traced to the keen interest our gifted Prime Minister has taken in the progress of Science and Technology. His last speech urging upon Industrialists to speed up their interest in science has evoked Nation-wide interest and we have heard from a very distinguished industrialist of India in which he promises the utmost help from Industrialists in all directions. I venture to say that a great many problems of poverty, disease and food can be solved if the scientific approach to the solution of these problems is followed up. The politician's method of plotting has failed everywhere. Power and Plenty now come through Scientific Planning. Planning by politicians without Science and Technology degenerate into plotting for political power.

I am glad to say here that these National Institutes will not only help industry, agriculture and commerce, they will also be of direct help to the masses. I have recently prepared a memorandum which I am circulating to all the Directors and Officers-in-charge of the National Laboratories requesting that they should orga-

nise themselves for voluntary service to better the lot of villagers in their neighbourhood by the aid of science. We have proposed that we should select a certain number of villages near the seats of our laboratories and visit them in teams on Sundays and holidays and help the villagers by improving their cottage industries, hygiene and sanitation and their general scientific knowledge by popular scientific talks. These visits from the eleven national centres will be arranged in a regular manner and we expect to raise funds for this help ourselves without going to the Government. There is nothing more infectious than personal contact and we hope this simple experiment will enable us to take science to the villages. We hope to bring into action soon 250 scientists for this purpose.

The participation in this ceremony by our respected Governor-General is a proof of His Excellency's abiding interest in science. Although we have heard that he has decided to relinquish his high post, His Excellency will always be our Rajaji and continue to occupy a position of honour and respect in our minds. The presence of our National Heroes, Pandit Jawaharlal Nehru and Sardar Vallabhbhai Patel, on this platform augurs well for the success of science in India. I recollect with great interest the reply I received from Mahatma Gandhi

when I sent him two couplets on our National Flag.

The English translation of the lines were:—

The National Flag is also a symbol of freedom and every nation has its own flag,

The unfurling and waving of which sends a thrill of joy through the hearts of the people,

Those who are followers of Mahatma Gandhi must of course remain peaceful but they should remember,

That underneath every National Flag that flies high is a strong rod and staff.

Mahatma's wit and humour are proverbial. He wrote to me to say that he had succeeded in creating a National Flag and he left it to the scientists to create a rod which will hold the flag firmly.

With your help, Sir, our respected leaders, we hope to create the rod and staff which will hold our flag high. The presence of the greatest living Chemist, Sir Robert Robinson, and his distinguished wife and the galaxy of foreign scientists, Condon of the U.S.A., Bernal of U.K., Englehardt of the U.S.S.R., Auger of the United Nations Organisation, Rydbeck of Sweden and others is nothing else but an indication of India's desire to move in unison with the rest of the world at best in the domain of science.

DIRECTORY OF CULTURE COLLECTIONS OF MICRO-ORGANISMS MAINTAINED IN INDIA

UNDER the auspices of the Indian National Committee on Type Culture Collection of Micro-organisms, it is proposed to issue a Directory of the Culture Collections of Micro-organisms maintained at various centres in India, including those in possession of individual specialists. In order to make this document authoritative, comprehensive and complete, the active co-operation of all microbiologists and others interested in type cultures of micro-organisms, is earnestly requested.

You are invited to send in the information to the undersigned before 31st March 1950, covering (1) the name of the Institution, (2) name of the investigator in charge, (3) nature of the collection, (4) objects of the collec-

tion, (5) lines of research, if any, connected with the collection, and (6) number of micro-organisms classified under (a) viruses, (b) bacteria, (c) yeasts, (d) fungi, (e) algæ, (f) protozoa, and others.

M. SREENIVASAYA

Convener,

Indian National Committee on Type
Culture Collection of Micro-organisms.

Section of

Fermentation Technology,
Indian Institute of Science,
Bangalore 3,

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PAPYROGRAPHIC* STUDIES IN NITROGEN METABOLISM OF MICRO-ORGANISMS

Part I. A Critical Study of the One-Dimensional Micromethod of Papyrography for the Analysis of Protein Hydrolysates

V. S. GOVINDARAJAN AND M. SREENIVASAYA

(Section of Fermentation Technology, Indian Institute of Science, Bangalore)

IN the course of our studies on the nitrogen metabolism of micro-organisms in relation to their mitotic cycle, we were faced with the problem of partitioning the nitrogenous constituents of the cell. Two other studies which presented the same problem were, (1) the amino acid make up of the malarial parasite and (2) the biological efficiency of the silkworm as a converter of the feed protein into silk protein.

The choice of the method would naturally be influenced by its simplicity, speed and ability to deal with micro quantities of the research material. Papyrography originated by Consdon, *et al.*,¹ offers a suitable method and meets most of the requirements. But, in view of the acute shortage of the essential solvents and developing reagents in this country, we have been obliged to prefer the one dimensional micro-modification of Rockland and Dunn,² which has been shown to be suitable for the analysis of amino acids in microgram quantities.

It was of interest to examine if this method could be extended for the detection, separation and estimation of amino acids in protein hydrolysates. The scheme entailed a study of (1) the choice of more effective solvents securing better resolutions of the mixture, (2) the standardisation of the experimental conditions, e.g., quantity of mixture under test, pH, temperature and time of experimentation, (3) conditions for development of colour with ninhydrin and (4) the influence of polypeptides, sugars and other interfering substances associated with hydrolysates of tissues and tissue fluids.

Experimental.—Test tubes 6" × 1/2" with 0.5 ml. of the solvent mixture for developing the chromatogram and filter-paper (Whatmann No. 1) strips measuring 135 mm. × 15 mm. tapering to 10 mm. assembled as in Fig. 1 were used for all the experiments. Later for obtaining better resolutions of the mixture, flat

bottomed test tubes 8" × 1", 1 ml. developing solvent mixture, and filter-paper strips 180 mm. × 20 mm. tapering down to 15 mm. were used. Solvent mixtures employed consisted of (1) phenol saturated with water,¹ (2) *n*-butanol saturated with water and (3) *n*-butanol saturated with aqueous acetic acid.³

The colour is developed with ninhydrin by spraying a solution of the reagent (0.1 per cent.) in *n*-butanol on the filter paper strip after developing the chromatogram.

Different mixtures of pure amino acids, 0.01M solutions and casein hydrolysate, 5-10 mgm. nitrogen/ml. have been used in the course of these studies. 0.5 to 1.0 μl of the solution is delivered by means of capillary pipette at a previously marked spot (see Fig. 1). Care is taken to secure

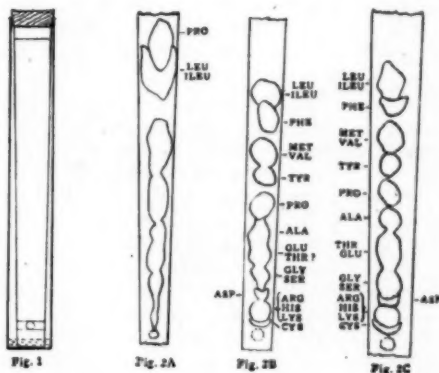


FIG. 1. Diagram showing strip in position for developing. The strip is fixed to the cork stopper by a pin. The solvent travels up to the line near the top.

FIG. 2 A.—Reproduction of Papyrogram of Casein (Acid) hydrolysate developed with phenol in small strip.

FIG. 2 B.—Reproduction of Papyrogram of Casein (Acid) hydrolysate developed with *n*-butanol / acetic acid in small strip.

FIG. 2 C.—Reproduction of Papyrogram of Casein (Acid) hydrolysate developed with *n*-butanol / acetic acid in longer strip.

(Abbreviations according to Brand and Edsall, 17)

* "Papyrography," a suggestive and appropriate term proposed by Dent⁶ for partition chromatography on filter-paper is used throughout this paper. Also the word "Papyrogram" is used to denote the map after developing with ninhydrin or other reagents.

a clean circular spot with a diameter not exceeding 2 mm. If the solution happens to be too dilute, the application of the solution at the spot may be repeated after drying out the previously applied solution.

An ascending distance of 125 mm. in the case of the small test tube and a distance of 160 mm. in the case of the bigger test tube are marked and the developing solvent generally takes about 2.5 hours and 4 hours respectively to attain these heights. After development of the column the strips are air dried, sprayed on either side with 0.1% solution of ninhydrin in *n*-butanol and oven dried at 100° C. for 10 minutes with a view to develop the colour. The strip is then viewed both by transmitted and reflected lights and the coloured areas marked with a pencil.

The R_f values¹ of individual amino acids both for phenol and for *n*-butanol/acetic acid were determined when run as single amino acids and also when present as simple mixtures and in protein hydrolysates. The R_f values of a few simple dipeptides have also been determined.

Our experience with phenol has not been very satisfactory for the separation of amino acids. The solvent is corrosive; the spots become diffuse and merge into one another.

n-Butanol saturated with water is found very unsatisfactory since the movement of amino acids was found to be very slow.

n-Butanol saturated with aqueous acetic acid³ gives a satisfactory separation with a complex mixture of amino acids. The spots, while some of them certainly represent composite spots of a group of closely related amino acids, were discrete and sharply defined.

With 180 mm. strip, better results were obtained.

Discussion.—Phenol, collidine and such solvents have been reported^{1,5} previously to decompose partially or fully some of the amino acids. As a result of this the spots spread out, a typical example being cystine giving an elongated spot with R_f values 0.25 to 0.5. Dent⁶ has suggested the oxidation of cystine to cysteic acid by H_2O_2 before development. Besides the sensitivity of the ninhydrin reaction for some amino acids also decreases.⁸ Alcohols being comparatively inert, they may be expected to cause no decomposition and this is borne out by our experience.

The R_f values of amino acids are not constant and cannot be relied upon for the identification.^{8,9} Various factors influence the movement of an amino acid in relation to the solvent, e.g., slight change in the quality of the solvent

TABLE I
 R_f Values of individual Amino Acids

Amino Acids	Solvent: Phenol		Solvent: <i>n</i> -Butanol/Acetic acid		
	Authors	Rockland & Dunn ²	Authors		Woiwod ^{3*}
			Small strip	Long strip	
Alanine	..	0.62	0.34	0.35	0.32
Arginine	..	0.53	..	0.14	0.11
Aspartic Acid	..	0.05	0.14	0.19	0.14
Cystine	..	0.25-0.5	0.06	0.08	0.03
Glutamic Acid	..	0.39	0.45	0.26	0.25
Glycine	..	0.48	0.34	0.2	0.19
Histidine	..	0.81	..	0.11	0.11
Isoleucine	..	0.89	0.72	..	0.85
Leucine	..	0.88	0.69	0.66	0.85
Lysine	..	0.41	..	0.12	0.11
Methionine	..	0.82	0.62	0.48	0.62
Phenylalanine	..	0.83	0.68	0.6	0.76
Proline	..	0.89	0.41	0.4	0.4
Serine	..	0.33	..	0.19	0.19
Threonine	..	0.57	..	..	0.25
Tryptophan	..	0.8	0.64	0.53	..
Tyrosine	..	0.61	0.5	..	0.53
Valine	..	0.82	..	0.47	0.62

* Calculated from reproduction of Papyrogram of mixture of Amino acids taking R_f value of proline to be same as ours.

or the associated constituent in the mixture, the quality of the paper, the degree of saturation of water in the mobile phase, etc. Many of these conditions of experiments can be controlled but occasionally, erratic R_f values were obtained.

It is fortunate, however, that the relative positions of various amino acids are in the same order, irrespective of variations of the individual R_f values. So with a known mixture of some amino acids as reference it should be possible to identify the constituents of an unknown mixture, when run simultaneously. Proline, because of its yellow colour and phenylalanine, because of the bluish purple colour with ninhydrin, constitute convenient reference points.

Martin¹⁰ in a paper to the symposium on Chromatography observes that "in two dimensional chromatograms 1 to 2 micrograms of amino acids could be detected and in single dimensional chromatograms half a microgram can, under favourable circumstances, be observed". From a study of the sensitivity of ninhydrin reaction in papyrography, Pratt and Auclair⁸ finds that 10 of the amino acids studied could be detected in microgram or less quantities, in a two-dimensional run with phenol and collidine. The sensitivity of the test is affected by the spreading of spot that occurs in two dimensional run over long hours and possible decomposition by developing solvents. Hence it could be expected that a short run and less reactive solvents would give a compact spot and increase sensitivity of the ninhydrin reaction. As in all micromethods, the quantity of the mixture to be used should be small, to avoid overloading and freakish development. We have been able to confirm the findings of Rockland and Dunn² that microgram quantities of amino acids could be detected in the microadaptation of the method. Besides we have found that the use of *n*-butanol acetic acid gives a more compact spot, thus aiding better separations and detections in an analysis of mixtures.

Attempts have been made by some 6-11-12 to use other reagents giving colour with specific amino acids. We have also used the Sakaguchi reagent for arginine, Pauly reagent for histidine, Ehrlich reagent for tryptopene and tyrosinase for tyrosene on filter paper strips after development and found them capable of testing microgram quantities. Other specific colour reactions are being tried.

The use of impregnated paper^{13,14} is another development which has proved useful in specific cases. We are experimenting with papers impregnated with starch, silica gel, etc. Prelimi-

nary results give promise of better development on starch impregnated papers in the form of sharp or compact spots though no difference could be found in separation.

Little work has been done on peptides separation,^{15,16} by papyrography. Available peptides have been studied in the 180 mm. strip and the results obtained with leucine, glycine and the dipeptides composed of these two are given below (See Table).

R_f Values of Glycyl-leucine and Leucyl-glycine

	Phenol		<i>n</i> -Butanol/ Acetic acid
	Authors Consdon, <i>et al.</i> ^{*15}		
Glycyl-l-leucine	0.90	0.87	0.65
Leucyl-glycine	0.74	0.86	0.63
Leucine	0.88	0.88	0.66

* Phenol with 0.1% Cupron and by descending boundary method.

With phenol, the leucylglycine occupies the lower half of an elongated spot, while leucine and glycyl leucine occupy the upper half of the spot. With butanol-acetic acid, leucylglycine and glycyl-leucine occupies the lower half of the leucine spot. The two peptides give a brown colour first^{15,16} and so is discernible from leucine in mixed spots. The colour of the dipetides spot however changes to purple slowly.

Summary.—A critical study of the microadaptation of papyrography has been made and improvements in the use of *n*-butanol/acetic acid as developing solvent and use of a slightly longer strip have been suggested. These improvements increase the sensitivity of the technique due to minimum decomposition and spreading of amino acids. The modified technique has been adopted for a routine qualitative analysis of protein hydrolysates.

Possibilities of extending and improving this technique by use of specific colour reactions for some of the amino acids and by use of impregnated papers with a view to secure better separations are discussed.

We wish to express our grateful thanks to the Council of Scientific and Industrial Research for financing a scheme of which this work forms a part. Our thanks are also due to the Director, Indian Institute of Science, for his kind interest.

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SCIENCE AND COMMONSENSE*

COMMONSENSE is no doubt a highly valued body of knowledge doing excellent service in the ordinary day-to-day affairs of life, but it cannot be claimed that it is in anyway infallible. One might say that the progress of science and mathematics has to a large extent depended on the discovery of the vast regions where the laws born of common experience are no longer valid, as also through the unearthing of the many pitfalls in the process of deductive reasoning on which commonsense generally depends.

There are many laws relating to the motion of terrestrial objects which are quite true in the immediate range and vicinity where we live and these are embodied in the Newtonian mechanics. But these laws break down when they are carried over to the region of very small bodies such as the electron, whose dimensions are of the order of 10^{-12} cm. (that of our own being 10^2 cm. or so) as well as in the region of the interstellar spaces where the order of reckoning is 10^{12} cm. or thereabouts. Thus, while it is possible to define the position and velocity of a terrestrial object such as an aeroplane with sufficient precision so as to be able to hit it, we are not able to do the same in the case of an object such as the electron without introducing an element of uncertainty.

Similarly, in the field of mathematics, there are many examples where the commonsense view comprehends only a very limited domain of the entire body of truth. For instance, the ordinary commutative law: $a \times b = b \times a$, on which commonsense algebra rests, is not universally true, and thus has to make room for the noncommutative algebra, wherein $a \times b$ is not equal to $b \times a$, but quite different.

Also, in the case of velocities approaching to that of light, the commonsense aspect has been found to be so inadequate indeed as to have given rise to the Theory of Relativity. According to this theory, the relative velocity of two particles approaching each other, of which the

velocity of the one is u and that of the other is v , is not their sum but may be considerably different, depending on how near their velocities are to that of light.

One more instance where the validity of common experience breaks down is in the province of temperature, where it is well known that all our sensations of life are limited to a few degrees this way and that of the freezing point of ice. But recent experience has shown that below this range, phenomena take place which need for their comprehension and explanation a modification if not also the abandonment of all commonsense ideas referring to conductivity, resistance, fluidity and so on. To illustrate: We all know that a loop of wire in which an electric current has somehow been introduced soon loses it, by reason of its electrical resistance; but, if the same loop be lowered into a bath whose temperature is in the vicinity of the absolute zero, it has been found that the current in the wire persists for a very great length of time. Obviously enough, the ordinary conception of resistance gathered in the temperature range of biological experience breaks down here.

The case is quite similar in the region of high temperatures also where chemical action is no more a mutual exchange of the outer electrons but assumes the character of nuclear transformation. The reason is pretty obvious; while at ordinary temperatures, the energy of chemical action is far too small to affect the nuclear stability at temperatures near a million degrees or so, the kinetic energy of the participants become comparable to that of the nuclear binding. Thus, we have in the latter case a veritable transmutation of the elements such as no alchemist might have dreamed of.

So, it would seem that the laws needed for a description of natural processes are by their very nature restricted to the range for which they hold good, becoming less and less true as we go farther away from that range. Considered in this light, commonsense represents only that body of knowledge which holds good in the range of sizes and dimensions comparable to our own, but breaking down for every other.

* Digest of an Address by Prof. H. J. Bhabha, F.R.S., Director, Tata Institute of Fundamental Research, Bombay, at the Indian Institute of Science, Bangalore, on 14th Feb. 1950.

FRIEDEL-CRAFTS POLYMERISATION

S. L. KAPUR

(Division of High Polymers, National Chemical Laboratory, Poona)

THE use of AlCl_3 and other metallic halides in Friedel-Crafts synthesis of aromatic compounds is well known. When these catalysts are added to such monomers as styrene and its derivatives, or isobutylene, a very rapid polymerization takes place. This polymerization is very sensitive to impurities although the well-known inhibitors like hydroquinone or oxygen have no effect on it. The molecular weight of the resulting polymer is very low and unlike addition polymerization it increases with the rise of temperature. The fact¹ that molecular weight reaches its maximum immediately after start, points it to be a chain reaction rather than a step reaction.

The mechanism of such a polymerization is quite different from that of a free radical polymerization and the nature of the catalyst is indicative of a polar mechanism. The salient features of such type of polymerization are discussed below:

The catalytic activity decreases in the series BF_3 , AlBr_3 , TiCl_4 , TiBr_4 , BCl_3 , BBR_3 , and SnCl_4 . There are certain minimum concentrations of the catalyst and the monomer below which no polymerization takes place. In industry BF_3 is used as the catalyst but in scientific work weak catalysts are used as they are amenable to controlled conditions. No polymerization takes place when thoroughly dried catalysts are used^{2,3}; a third component, usually water or an alcohol is required in small amount.

The monomers in this type of polymerization contain in general an electron rich double bond. Thus substituents in the following typical monomers are of the electron releasing type:— (1) Styrene, (2) α -Methyl Styrene, (3) Isobutylene, (4) Indene, (5) Alkyl Vinyl Ether.

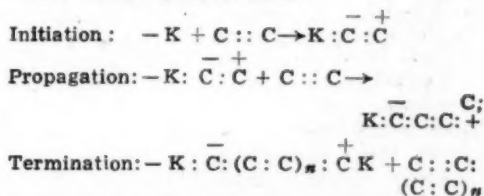
It follows that monomers like vinyl chloride and acrylates which contain electron-attracting substituents cannot be polymerized by such catalysts.

In contrast to inhibition in free radical polymerizations, steric factors play an important role in this type of inhibition. Amines and ethers are some of the typical inhibitors. Amines react with the catalyst to form a complex compound. It has been shown by Brown and Co-workers⁴ that dissociation of the above type of complexes is governed by steric factors. So, it follows that complexes of secondary and tertiary amines with the catalyst will be dissociated to a larger extent than complexes of primary amines. Thus di- and tri-*n*-butyl amines and dimethyl aniline

are about equally effective inhibitors of styrene polymerization while *n*-butylamine is weaker.⁵ This order is however, changed to di-*n*-butylamine, tri-*n*-butylamine, dimethyl aniline and *n*-butyl amine in the polymerization of α -methyl styrene for the likely reason that the reaction between the free amines and chain propagating species (probably a carbonium ion) is also subject to steric hindrance. The α -methyl styrene carbonium ion $\text{R-C}(\text{CH}_3)\text{C}_6\text{H}_5$ is sterically more hindered than the styrene carbonium ion, which explains the difference in the action of secondary and tertiary amines.

As a consequence of the popular nature of these polymerizations it is to be expected that dielectric constant of the medium strongly influences the reaction, a fact that has been actually observed in the case of α -methyl styrene⁶ and styrene. In the case of styrene, reaction rates show a rapid increase whereas molecular weight is only slightly affected, which indicates that inhibition reaction is strongly favoured while termination is depressed in high dielectric constant media.⁷

Eyring and coworkers⁸ suggested that such a polymerization proceeds through a dipolar intermediate. It is assumed that catalyst merely increases the polarity of the double bond and termination is brought about by the snapping of the catalyst from the chain and they suggested the following mechanism.



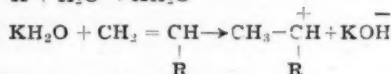
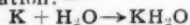
where K denotes the catalyst.

This scheme does not account for the findings of Polanyi and coworkers^{2,4} that a co-catalyst is positively required for starting the reaction.

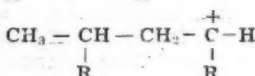
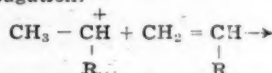
It is clear that if catalyst increases the polarity of the olefinic double bond, BF_3 should be a more effective catalyst than the salt ' $\text{BF}_3\text{H}_2\text{O}$ ' in which the electron accepting capacity of BF_3 is satisfied. This is not the case. Moreover the monomolecular termination (also postulated by Price⁹) should be practically unaffected by a change in the dielectric constant of the medium. George and Wechsler⁷ and others⁶ have very recently shown that termina-

tion is depressed by increase of dielectric constant and all these facts support the mechanism approved by Polanyi and coworkers.

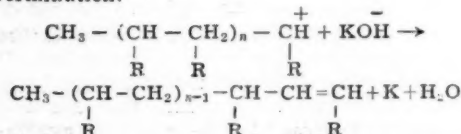
Initiation:—



Propagation:—



Termination:—



The termination being a reaction between oppositely charged ions will be depressed in a medium of high dielectric constant. There is a

note of caution to be observed in accepting this mechanism since we are not dealing with free ions but rather with ion pairs or with potential ions and the proposed mechanism is yet open to criticism.

Progress in this field of polymer chemistry has been slow mainly because of the sensitivity of the reaction to impurities and its high rate in absence of solvents. No reliable kinetic investigations of such polymerizations have been reported as yet.

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2. Evans, A. G., Eolden, D., Plesch, P. H., Polanyi, M., Sdianer, H. A., and W. A. Berger, M. A., *Nature*, 1946, **157**, 102.
3. Evans, A. G., and Polanyi, M., *J. Chem. Soc.*, 1947, **252**.
4. Brown, H. C. and co-workers, *J. A. C. S.*, 1944, **66**, 431-35; 1945, **67**, 374-78, 1765; 1947, **69**, 1137.
5. George, J., Mark, H. and Wechsler, H., A. C. S., meeting, Chicago, 1947.
6. Pepper, D. C., *Nature*, 1946, **158**, 789.
7. George, J., and Wechsler, H., 'Unpublished results,' Polytechnic Inst., of Brooklyn, New York.
8. Mulburt, H. M., Herman, R. A., Tobolsky, A. V., and Eyring, H., *Ann. N. Y. Ac. Sc.*, 1943, **44**, 371.
9. Price, C. C., *ibid.*, 1943, **44**, 351.

ADVANCES IN MICROBIOLOGY*

MICROBIOLOGY has now come of age; separate Research Institutes for the study of microbiology have been founded and the latest in the field is the one organized by Professor Waksman. The rapidly accumulating wealth of fundamental knowledge and the spectacular growth of industries based on the discoveries made in the field of microbiology, have hastened this happy recognition of microbiology as an independent and well-defined branch of science. Microbiology has, in recent years, invaded the fields of genetics, nutrition and intermediary metabolism and micro-organisms have continued to provide for fundamental studies a convenient unicellular unit of life of unexpected flexibility and resourcefulness.

It was inevitable that such a rapidly growing and fruitful branch of science should result in the birth of the *Annual Review of Microbiology*—the third in the lineage of the brilliant family of *Annual Reviews*.

Seventeen reviews encompassing the morphological, cytological, genetical, immunological, pathological, chemotherapeutical, epidemiological, nutritional, biochemical, medical and industrial facets of microbiology, have been presented

in the first volume by a group of top-ranking and active workers. Of the 17 contributions, thirteen are from the laboratories of the U.S.A., three are from England and one is from France. The total number of references to literature cited in the volume is nearly 2,000.

Protozoa, fungi, bacteria and viruses are all covered. Investigators interested in the various aspects of protozoal diseases including malaria will find the four contributions, morphology and cytology of protozoa by Wenrich, antigenic variation in protozoa by Harrison, life cycle of malarial parasites by Huff, and the problem of growth factors for protozoa by Lwoff, extremely stimulating and suggestive. Those interested in nutrition and intermediary metabolism will welcome the contributions of Woods and Gale on Bacterial Metabolism and Nitrogen Metabolism. Benedict and Langlykke have reviewed the evergrowing field of antibiotics, while the important aspects of Industrial Fermentations are covered by a review by Johnson. The review on chemotherapeutic agents by Lourie constitutes a thought provoking article which will serve to stimulate and rationalise chemotherapeutical research. These reviews have a much wider appeal than what may be apparent from the title. By the publication of the new series of reviews devoted to microbiology, the *Annual Reviews Inc.* have earned the gratitude of a wide circle of investigators.

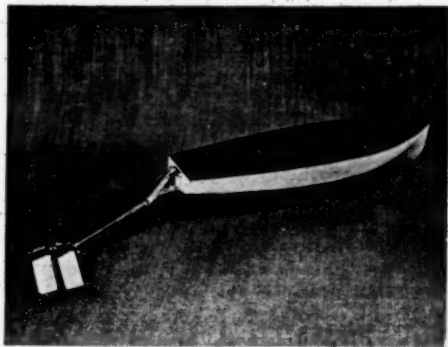
* *Annual Review of Microbiology*, Vol. I. Edited by Charles F. Clifton, Sidney Raffel and H. Albert Barker. (Annual Reviews Inc., Stanford, California), 1947. Pp. vii + 464. Price \$ 6.00.

SHIP PROPULSION BY WAVE MOTION

A NEW method of driving a ship by wave motion has been invented by Mr. Sydney McCubbin of Black Rock, Melbourne, by utilising power obtained from the surface waves of the sea. His invention consists of a loaf or fin of suitable dimensions and materials, flexibly attached, or hinged to the craft, the free edge moving in a suitable arc. A spring tension is provided at, or near the hinge. When the unit lies beneath the surface at the end of an arm, a forward thrust is created by the combined factors of the rise and fall of the water, resistance of the water to the fin, and the return action of the fin.

The angular positions assumed by the leaf are proportionate to the pressure applied, to the resistance of the water, and to the return tension of the leaf.

Mr. McCubbin explains that it is the forward thrust which can be utilised to obtain power from the surface waves of the sea for the propulsion of various forms of water-craft. Single or multiple wave units may be attached to these craft in such a manner that advantage can be taken of the difference of the relative vertical or oscillating motion of the sea surface, and of the wave unit. The inventor says that his observations of a tadpole or a fish when swimming showed him that the tail did not merely move, but it also developed a true wave form. This started from the nose and flowed smoothly with increasing amplitude (not frequency) to the end of the tail.



Model craft embodying the wave propulsion unit. The tension at the hinged edge returns the leaves to their neutral position after being moved in either direction by the action of the water.

Detailed study of the wave form of movement showed Mr. McCubbin that the bodies of fish of conventional shape assumed the form of a full cycle on a horizontal plane. A tadpole at rough estimate assumed the form of a cycle and a half, but without special equipment it was

difficult to judge this accurately. On the other hand the wings of a bird covered about a fifth or a sixth of a cycle only. The wings of insects in most instances had a greater cycle coverage than the wings of birds.

A special wave-propulsion raft could be designed to be incorporated in ships' equipment and used to aid survivors of wrecks. This raft would be of conventional construction, except that it would be fitted with special arms, carrying at their ends flexibly mounted fins, or leaves. These could be so arranged that the oscillating motion of the raft, due to the action of the waves, would cause the leaves to rise and fall. Thus moved from their normal position horizontally in the water, the deflection of the leaves would impart a forward thrust to the raft.

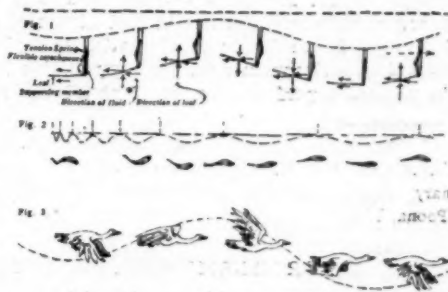


FIG. 1 shows the flexible attachment of the boat which, by reason of its movements, create the wave form. FIGS. 2 and 3 illustrate the similarity of the wave forms of a fish and a bird. The wave form from the fish's nose flows with increasing amplitude to the end of its tail. The bird adapts its wings to different speeds by a simple variation of pitch.

When not in use the leaves could be folded along the sides of the raft, where special cavities could be provided to receive the more easily damaged members of the unit.

Mr. McCubbin states that his experiments with model boats had also convinced him that wave propulsion could be used to illuminate marine beacons. A pear-shaped buoy ballasted to float in water could have a number of flexibly mounted leaves (wave units) arranged horizontally around and near the top of the buoy, but below the surface of the water. When the water was agitated the buoy would rotate a central spindle (held stationary by a vertical vane), and would enable a generator to charge self-contained batteries and supply current to the beacon. The beacon could be anchored in one spot by a cable attached to the base of the stationary vane and anchorage point.

(By courtesy of the Australian
High Commissioner in India)

PHYSIOLOGY OF HEALTH AND PHYSICAL FITNESS*

IN the course of his presidential address, Dr. Kalidas Mitra emphasised the importance of health, as a natural asset, contributing to the prosperity of any country either agricultural or industrial. Unfortunately physiological research had received scant attention and had not evolved a satisfactory standard for positive health and fitness. Lack of co-ordinated and active collaboration among workers in physiology, hygiene, clinical medicine and public health has been responsible for this unhappy state of affairs; the clinician being interested in cure and the public health worker in prevention of disease are both in a position to pose a number of problems for the hygienist and the physiologist. Another important cause is the racial and genetic complexity of the human organism. Therefore it is difficult to determine absolutely precise health standards for all men. For all practical purposes, the health and fitness of an individual is the degree of adaptation to rapidly changing environments without appreciable loss in power of performance, or if at all the rate

of recovery. A standard of this order would go a long way.

In the last few decades nutrition has been taken as an important factor in the creation and maintenance of health. From the observations derived from the prisoners of war camp and other sources, during the recent wars the clinical symptoms attributed to mal or under-nutrition are not uniform in all cases. The study of physiology of industrial workers and defence personnel of various categories have considerably advanced particularly in America and the results have largely contributed to the welfare and efficiency of the workers and to an improvement in the performance of military personnel. The author bases the criteria of good health on physique, organic efficiency, and motor fitness, i.e., around body development and height-weight ratio, muscular power, and efficient cardiovascular mechanism, vital capacity and sound condition of the body fluids, particularly blood and its constituents. These data should be combined with the findings of a thorough clinical examination. The author concludes by offering a few suggestions for future work. The author who is a public health worker has taken some pains to collect data for this address.

Dr. K. P. MEXON.

* Presidential Address by Dr. Kalidas Mitra, M.B., D.P.H., D.T.M. & H., F.N.I., at the Medical and Veterinary Section, Indian Science Congress, 37th Session, Poona, 1950.

PROBLEMS AND PROSPECTS OF INDIAN ANTHROPOLOGY*

IN the course of his presidential address, Dr. C. von Furer-Haimendorf emphasised the need for the co-ordination of anthropological and archaeological research in India. He indicated how certain geographical conditions in this country have made possible the co-existence of diverse cultures from the semi-nomadic food gatherers to the city dwellers. The earlier civilizations have avoided conflict with advanced civilizations by isolating themselves in refuge areas.

Most of the aboriginal cultures represented to-day by forest tribes who are given to shifting cultivation without the use of the plough or wheeled transport could be correlated, according to Dr. Haimendorf, to the early neolithic civilizations of South East Asia exemplified by the Brahmagiri stone axe culture and characterized by the use of partially or wholly polished stone axes with pointed butt and oval cross-section. Here lies the importance of

Dr. Wheeler's excavations at Brammagiri which have enabled us to date not only the megalithic culture of South India but also the preceding neolithic and chaeolithic culture strata. Dr. Haimendorf considers that the Brahmagiri stone axe people had a culture resembling that of the present day aboriginal populations of shifting cultivators. He also considers that the megalithic builders of South India who succeeded them were probably Dravidian-speaking peoples established in South India late in the first millennium B.C.

The latter part of his address considers the value of anthropology for the solution of the socio-economic problems of primitive peoples. Social planning for the development of backward areas should be based on sound anthropological knowledge which has been useful in the rehabilitation and education of the aboriginals of Hyderabad. In conclusion Dr. Haimendorf said that it was gratifying to find that anthropology is being applied to establish better racial relations among peoples and to promote international goodwill.

* Summary of the Presidential Address to the Section of Anthropology and Archaeology, Indian Science Congress (1949), Poona.

LETTERS TO THE EDITOR

	PAGE		PAGE
The Photosensitivity of Neon Lamps: The Positive Joshi Effect—H. J. ARNIKAR ..	47	On Sampling Studies in the Estimation of White Fly Incidence on Sugarcane—K. L. KHANNA & K. S. BANDYOPADHYAY ..	58
The Absorption Spectrum of Anisole—K. SREERAMAMURTI ..	48	On "Morellin", the Antibacterial Principle of the Seeds of <i>Garcinia morella</i> Desrous—R. RAGHUNANDANA RAO AND S. NATARAJAN ..	59
Black Sand Concentrates of Vizagapatam Coast—C. MAHADEVAN AND B. NATESWARA RAO ..	48	Active Relaxation of Unstriated Muscle during Inhibition Produced by Adrenaline—SUNITA INDERJIT SINGH AND INDERJIT SINGH ..	60
A Comparison of Mt. Abu Temperature Observations Recorded at 1700 Hrs. I.S.T. with the Free Air Temperature over Jodhpur at the Same Level—K. L. BHATIA ..	49	Inheritance of Sparse Lint Mutant in <i>Conocladus Cotton</i> —R. BALASUBRAHMANYAN AND V. SANTHANAM ..	60
Studies on the Reducing Substances of Semen—A. ROY, S. BHATTACHARYA, S. N. LUKTUKU AND P. BHATTACHARYA ..	50, 52	Polycarpy in <i>Cicer arietinum</i> —K. N. KAUL AND M. S. SOLANKI ..	61
The Twin Laws of the Plagioclase Felspars of Charnockites—P. R. J. NAIDU ..	51	Natural Hybrids in <i>Arachis nambyquaræ</i> T. SRINIVASA MURTHY & K. GOPALA IYENGAR ..	62
The Microbiology of Indigenous Pickles and Preserves—MADHU RAGHUNATH AND J. V. BHAT ..	53	Foam Disease of Citrus in Assam—S. CHOWDHURY ..	62
Antibiotic Principles from <i>Moringa pterygosperma</i> —P. A. KURUP AND P. L. NARASIMHA RAO ..	54	Wilt of <i>Casuarina</i> —D. MARUDARAJAN, T. S. RAMAKRISHNAN AND C. K. SOUMINI ..	63
Lorentz-Lorenz Expression as an Analytical Constant for Oils and Fats—M. R. NAYAR, S. C. ROY AND R. S. SRIVASTAVA ..	54	Note on <i>Orobancha cernua</i> Læf—D. MARUDARAJAN ..	64
Studies in Host-Parasite Relationship in Untreated Chicks Infected with <i>P. gallinaceum</i> —V. R. SRINIVASAN, V. RAMAMURTHY, A. S. RAMASWAMY, R. RAMA RAO AND N. N. DE ..	56	A New Root-Rot Disease of <i>Cyperus</i> Spp.—K. A. MAHMUD ..	65
		Colchicine Induced Polyploidy in Spinach—S. L. TANDON ..	66
		The pH Tolerance of an Aquatic Plant Community—GIRJA DAYAL-SRIVASTAVA ..	66
		Damping-off of Cabbage, Cauliflower and Knolkohl Caused by <i>Pythium aphanidermatum</i> (Eds.) Fitz.—K. A. MAHMUD ..	67

THE PHOTOSENSITIVITY OF NEON LAMPS: THE POSITIVE JOSHI EFFECT

OM PRAKASH¹ has reported a 3-14% lowering of the "flashing voltage" of the GEC neon lamps as a consequence of their irradiation by external light, the effect being greater with blue than with green or yellow light. Such a result is to be expected from the well-known Joshi effect observed in media excited by electrical discharge.

Prof. Joshi^{2,3} showed (i) that the conductivity of a gas under discharge is determined in part by the excess of the operative potential over its threshold value, and (ii) that photoelectric emission occurs from an electrode layer on irradiation leading to enhanced conductivity. A lowering of the threshold potential under

light is thus implied in his theory. As, however, electron emission from the solid-gas boundary layer is involved, it follows, that the phenomenon will be independent of selective light absorption by the gas phase³, and that the extent of lowering of the threshold potential will be in the order of frequency of the light employed, being determined by the excess energy of the incident photon over the work function of the layer which is known to be small enough to render even visible light effective.^{3,4,5}

Thus, a lowering of the starting potential due to irradiation of the type observed by Om Prakash¹ follows as a primary consequence of Joshi's theory in all systems, unless secondary processes, such as, the formation of negative

ions, space charge sheath, etc., are superimposed on the photoelectric emission. The occurrence of these secondaries leads to the production of the familiar negative Joshi effect, now observed in almost all the permanent gases, metallic and other vapours, elemental and compound.^{6,7,8} Joshi generalised⁹ that low exciting potentials as near the threshold condition, should favour the positive effect. This last amounting to several hundred per cent. increased conductivity under light, and accompanied as is to be anticipated, by a marked lowering of the threshold potential, has been observed in several systems as hydrogen,¹⁰ air,^{8,11} and iodine vapour¹² in these Laboratories. It is surprising that Om Prakash should have made no reference to these findings while describing what is but the positive Joshi effect in neon.

Chemical Laboratories,
Benares Hindu University,
December 22, 1949.

H. J. ARNIKAR.

1. On Prakash, *Curr. Sci.*, 1949, **18**, 490. 2. Joshi, *Ibid.*, 1939, **8**, 548, and 1940, **9**, 535. 3. —, *Presid. Address Chem. Sect., Ind. Sci. Cong.*, 1943. 4. Deo, *Proc. Ind. Acad. Sci.*, 1949, **29**, 23. 5. Tawle and Gopalakrishnan, *Ibid.*, 1949, **29**, 171. 6. Deshmukh, *Jour. Ind. Chem. Soc.*, 1947, **24**, 211. 7. Prasad, *Nature*, 1949, **164**, 69. 8. Arnikar, *Proc. Ind. Sci. Cong., Phys. Sect.*, 1949. *Abstr. Nos.* 13 and 14. 9. Joshi, *Curr. Sci.*, 1947, **16**, 19. 10. Arnikar and Agashe, *Proc. Ind. Sci. Cong., Phys. Sect.*, 1950, *Abstr. No.* 62. 11. Visvanathan and Rao, *Proc. Ind. Acad. Sci.*, 1949, **29**, 117. 12. Deshmukh, *Ibid.*, 1949, **29**, 243.

THE ABSORPTION SPECTRUM OF ANISOLE

THE ultra-violet absorption spectrum of anisole consisting of about 150 bands was photographed in the region λ 2860–2400. Similar to the Sponer-Wollman interpretation of monosubstituted benzenes, this system can be interpreted as due to the forbidden $A_1 \rightarrow B_1$ electronic transition, allowed as a result of the reduction in symmetry of the benzene molecule from D_{6h} to C_{2v} due to the substitution of OCH_3 . The (0, 0) band is located at ν 36401. Bands corresponding to the Raman frequencies of 264, 505, 610, 816, 991, 1021, 1066 and 1297 cm^{-1} were identified towards the red end of this band. Analysis of the bands lying to the violet end led to the identification of the upper state frequencies of 481, 516, 755, 938, 950, and 1261 cm^{-1} . Fairly strong bands associated with the 0, 0 as well as the other intense bands are interpreted as giving the difference frequencies of 36, 56 and

128 cm^{-1} combinations have been found between these frequencies and the fundamental, and other combination frequencies.

A full report of the analysis and the assignment of the frequencies will be published elsewhere.

Physics Department, K. SREERAMAMURTHY.
Andhra University,
Waltair,
December 30, 1949.

BLACK SAND CONCENTRATES OF VIZAGAPATAM COAST

THE study of the beach sands of the Vizagapatam-Waltair coastal area has been extended in the present studies from beyond Waltair to Bhimilipatam further north on the coast through a distance of about 15 miles. The sea-coast is fringed by hill ranges consisting mainly of khondalites, intruded by pegmatites and in a few places by charnockites. The black sand concentrates in this area are far more extensive than in the Vizagapatam-Waltair beach area. Wide spreads of these occur in different places, and attempts were made to roughly estimate the reserves of the black sands now available, to a depth of about 5 feet from the surface. The dimensions of the black sand concentrates vary from place to place, the biggest being about 500 feet by 100 feet with a thickness of 8 inches. The pits put down in the beach to a depth of 5 feet reveal several layers of black sands from about an inch to 8 inches in thickness.

The beach between Kallasa hill promontory to Bhimilipatam can be divided into three distinct units. The first, from the promontory to Eradada village, a distance of about 4 miles, comparatively barren of black sands; the second, from Endada to Dibbalapalem—a distance of 5 miles—with red garnetiferous sands predominating, and the third and last strip, to Bhimilipatam, where black sand concentrates occur in great profusion. It has been estimated that the total quantity of the black sands in the area is 740,000 cubic feet. Of this, in the bulk samples (averaging both the richer and poorer concentrates) magnetite is 36%; garnet, 15%; ilmenite, 5.3%; monazite, 3%; and zircon is 0.6%.

In the richer black sand concentrates, however, monazite is over 8% and ilmenite, about 14%. It is quite easy to define along the beach, the areas where patches contain richer concentrates of monazite and ilmenite. It has been estimated that in sands in this area, there are

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about 37,000 tons of magnetite, 12,500 tons of garnet, 5,700 tons of ilmenite, 3,100 tons of monazite and 550 tons of zircon down to a depth of about 5 feet from the surface.

On account of the fluctuations in the beach configuration, there is a certain amount of redistribution of the concentrates. Nevertheless, the estimates given here are claimed to be conservative and of the right order of magnitude. It may be pointed out that annually the streams add a considerable amount of black sand concentrates during the monsoon months, which are sorted, graded and deposited on the beach. The black sand concentrates extend much further down to depths and the yield will be considerably greater, in case exploitation of these rich and important deposits is initiated.

A detailed paper embodying the results of the study will be published elsewhere by one of us (B.N.).

Geology Dept.,
Andhra University,
Waltair,
December 24, 1949.

C. MAHADEVAN.
B. NATESWARA RAO.

1. Mahadevan, C., and Sri Ramadas, A., "Monazite in the Beach Sands of Vizagapatam District," *Proc. Ind. Acad. of Sci.*, 1948, **27**, 275-78. 2. Mahadevan, C., and Sathapathy, N., "The Hons of Monazite in the Vizagapatam Area," *Curr. Sci.*, 1948, **17**, 297.

A COMPARISON OF MT. ABU TEMPERATURE OBSERVA- TIONS RECORDED AT 1700 HRS. I.S.T. WITH THE FREE AIR TEMPERATURES OVER JODHPUR AT THE SAME LEVEL

In this note, the Mt. Abu temperatures (and also humidities) have been compared with the free air temperatures (and humidities) recorded over Jodhpur. The comparison, although not very precise on account of the stations not being quite close to each other (distance 115 miles*) and the observations not being exactly synchronous, gives a fairly good idea of the corrections to be applied.

Free air values of dry bulb temperatures at Jodhpur corresponding to the level of Mt. Abu, i.e., 1.2 km. above sea level, were picked up from the daily tephigrams prepared from the radio-sonde ascents made at about 2000 hrs. These were directly compared with the Mt. Abu 1700 hrs. observations, no correction being applied for the time interval between the two sets of observations as it was never more than 4 hours and as the diurnal change in the free air at 1 km. above ground is negligible.

The frequency distribution of seasonal differences of free air and mountain temperatures has been shown in Fig. 1.

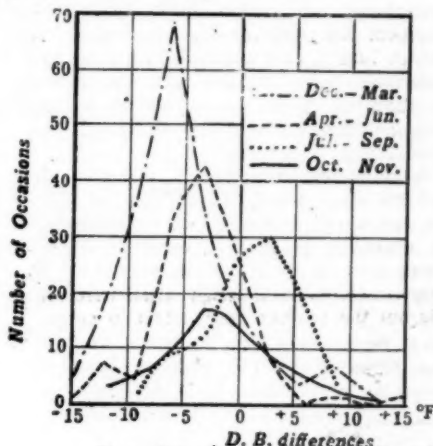


Fig. 1. Free air (J) minus mountain (M)
DRY-BULB TEMPERATURE.

It will be seen that:—

(a) each of the frequency curves has a sharp peak indicating thereby that the differences are mainly and closely distributed round the mean value and are not scattered haphazardly, and, (b) the number of observations is fairly large and well distributed throughout the year.

Wet bulb temperatures and relative humidities were also compared in the same manner as the dry bulb temperatures.

The results have been shown graphically along with that of dry bulb temperatures in Fig. 2.

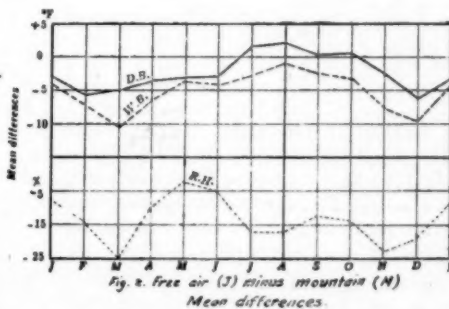


FIG. 2

The mountain is warmer than the free air except in the monsoon months. This result is

opposed to that found in the case of Cherat-Peshawar comparison¹ as the latter was in respect of 0800 hrs. in the morning. The wet bulb temperatures are higher over the mountain throughout the year more so during the post-monsoon and winter period. The relative humidities are also higher over the mountain throughout the year, the differences being less during summer.

Conclusions:

The following conclusions may be drawn from the results:—(i) To reduce the Mt. Abu afternoon temperatures to free air temperatures, it is necessary to apply a correction of -5°F. in winter, -3°F. in premonsoon, $+1.5^{\circ}\text{F.}$ in monsoon and -1.5°F. in the post-monsoon period,†

(ii) For wet bulb temperatures an approximate correction of -7°F. may be applied during the period of October to March, of -4.5°F. during pre-monsoon period and -2.5°F. during the monsoon period,

(iii) For relative humidities a correction of -15% may be applied throughout the year except during the pre-monsoon period when a correction of only -5% is necessary.

Regional Met. Centre,
New Delhi,
January 31, 1950.

K. L. BHATIA.

* This is rather high as compared with the distance of 30 miles in the case of Cherat-Peshawar comparison by the author.¹ However, it is much less than the distance (of more than 250 miles) in the case of Simla Agra comparison by Harwood.²

† The year has been divided into four seasons as follows:—

- (1) Winter—December to March.
- (2) Pre-monsoon (summer)—April to June.
- (3) Monsoon—July to September.
- (4) Post-monsoon—October and November.

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2. Harwood W. A., *Mem. Ind. Met. Dept.*, 24, Pt. 6. 182.

STUDIES ON THE REDUCING SUBSTANCES OF SEMEN

Part III. Fructolysis in Buffalo Semen and the Relation of Fructose Content of Semen to the Volume of Ejaculate and Sperm Concentration

In connection with artificial insemination carried out with buffaloes, it was experienced that their semen does not keep as well as bull semen in preservatives like Egg-Yolk-Citrate and Egg-Yolk-Phosphate used for the latter; subsequent studies show that it has a high percentage of

non-fructose reducing substances compared to goat, sheep or bull semen. An investigation was, therefore, started to study the chemistry of buffalo semen with a view ultimately to develop suitable media for its preservation. In this communication is reported the rate of utilisation of the sperm metabolite, i.e., fructose present in ejaculated semen and its relation to sperm concentration/unit volume (Table I), and the relation of the fructose and sperm concentration to total volume semen (Table II).

TABLE I

Sperm concentration (million/ml.)		Fructose (mg./100 ml.)	Fructolysis (in 3 hours)
Range	Mean		
0-499 *(30)	394 ± 13.6	1015 ± 50	25.3% ± 2.1
500-999 *(48)	737 ± 16.1	855 ± 35	39.3% ± 3.0
1000-1499 *(22)	1149 ± 26.1	729 ± 60	59.4% ± 5.8

* Number of observations.

TABLE II

Volume (ml.)		Fructose content (mg.)	Sperm con- centration (million)
Range	Mean		
0.50-1.00 *(19)	0.84 ± 0.03	6.44 ± 0.65	698
1.01-1.50 *(21)	1.27 ± 0.08	10.90 ± 0.68	924
1.51-2.00 *(15)	1.77 ± 0.10	15.67 ± 0.48	1237
2.01-2.50 *(12)	2.20 ± 0.12	20.75 ± 2.19	1650
2.51-3.00 *(12)	2.78 ± 0.12	25.58 ± 2.50	1686
3.01-6.90 *(21)	4.22 ± 0.06	39.42 ± 2.87	2955

* Number of observations.

The results show that the relations of (a) sperm concentration/unit volume to fructolysis and (b) volume of ejaculated semen to the concentration of fructose are linear, similar to those in the ram and the goat. Also, fructose concentration in all the three species has been found to be inversely related to sperm concentration.

Our thanks are due to Dr. S. Datta, Director, Indian Veterinary Research Institute, for his continued interest in the work.

Animal Genetics Section,
Ind. Vet. Res. Institute,
Izatnagar,
December 20, 1949.

A. ROY.
S. BHATTACHARYA.
S. N. LUKTUKU.
P. BHATTACHARYA.

THE TWIN LAWS OF THE PLAGIOCLASE FELSPARS OF CHARNOCKITES

The plagioclase feldspars occurring in the rock types of the "Charnockite series" collected from various Charnockitic areas in India, from Nilgiris in the South to Orissa in the North, were examined by the Fedorow method, as expounded by Prof. Dr. Max Reinhard.¹ 84 feldspar grains from 34 rock sections were determined. The twin laws showed the following distribution:—

province, except that the Carlsbad law and the Albite-Carlsbad, so often noted in the Effusive rocks and some Plutonic rocks, are typically absent here. These two laws, however, are found in the pigeonite-metadolerite dykes associated with the Charnockites.⁶ But the mineral composition and textural characters of these dykes are very different from the rest of the Charnockite series. All the types of twin laws, here recorded, normal, parallel and complex, are represented in the Norites. (010) as twinning plane is more common in the Char-

Nature of Plagioclase	Percentage of Anorthite	Normal law				Parallel law			Complex law		Rock types as described by Holland
		Albite	Manebach	Baveno right	Baveno left	Carlsbad	Acine = Manebach-Ala	Pericline	Ala	Albite-Ala	
Oligoclase ..	15-25%	..	..	..	..	..	1	..	..	..	Acid charnockites
Oligoclase to Andesine ..	25-35%	9	1	..	..	..	4	..	8	..	Gneisses
Andesine ..	35-50%	20	..	..	..	..	16	..	..	..	Intermediate Charnockites, Gneisses, Norites, Granulite, Amphibolites
Labradorite ..	50-70%	6	2	..	..	..	2	..	..	1	Norites
Bytownite ..	70-90%	1	..	..	..	..	..	..	..	1	Basic Charnockites
Total of laws		36	3	..	..	..	3	20	..	10	
Percentage		39=54%				23=32%			10=14%		

The accuracy of the above determinations was checked by four methods:—(1) by comparing the angles measured between the optic axial planes of two individuals of a grain, with the values recorded by Duparc and Reinhard,² for the various twin laws; (2) by comparing the angles α_1 , α_2 , β_1 , β_2 , γ_1 , γ_2 with the values of Köhler,³ (3) by constructing the extinction angles by the Biot-Fresnel law, from the optical data and cleavage directions measured on the Fedorow stage, and comparing these angles with the values of Duparc and Reinhard,² and (4) by constructing the poles of the twin axes by Nikitins' and Berek's methods⁴ to distinguish normal from parallel and complex laws.

The Albite-ala law is highly developed in the feldspars, which are intermediate in composition between oligoclase and andesine, as noted by Dr. Coulson.⁵ The largest proportion (36 out of 72) of the grains determined is andesine, and the two laws—Albite and Pericline=Acine are about of equal frequency in this plagioclase. No twin law is distinctive of the Charnockitic

nockite series than (001). In 46 instances, (010) is the twinning plane and in 26 instances (001) is the twinning plane. The width of the albite lamellae measured from oligoclase to bytownite, in this series, generally accords with the theoretical deductions of Donnay.⁷

On the basis of the plagioclases determined, the Charnockites can be divided into the Acid group with oligoclase to andesine (25 to 35% An.), and the Intermediate group with andesine (35 to 50% An). The gneisses correspond to these Acid and Intermediate divisions. The Norites are of two types:—(1) with andesine (40-50% An) and (2) with labradorite to bytownite. The hypersthene granulites and amphibolites have andesine (40-50% An).

The Charnockite feldspars follow the Deep Temperature optics of Tertsch.⁸ A collective diagram of the (010) poles does not show the wide "strewing" noted in effusive rocks. A amphibolites have andesine (40-50% An).

My grateful thanks are due to Prof. Dr. Max Reinhard, and especially to his assistants,

Drs. O. Grütter and E. Wenk, under whose direction this work was carried out.

The Mineralogical Institute,
University of Basel,
Basel,

P. R. J. NAIDU.

Switzerland,
December 27, 1949.

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STUDIES ON THE REDUCING SUBSTANCES OF SEMEN

Part II—Relation of Sperm Concentration and Semen Volume to Fructose Content Fructolysis and Methylene-blue

Time Reduction

In continuation of our previous communication¹
on the total reducing substances, fructose and

ascorbic acid present in the semen of buffalo-bulls, rams and goats, we report here the relation of the various seminal characteristics in healthy rams to sperm concentration/ml. (Table I). Their relation to total volume and total number of spermatozoa/ejaculate is presented in Table II.

Table I shows that the rate of fructolysis is linearly related to sperm concentration/ml.; also that with the increase of sperm concentration, the fructose content in the ejaculated semen as well as the methylene-blue reduction time decrease. The relationship between the rate of fructolysis and total sperm/ejaculate (Table II), is practically linear upto a concentration of 3,500 millions. Beyond that range, however, the rate of fructolysis begins to decline, being due, not to the dilution of sperm concentration/unit volume, but to the higher concentration of fructose present. The time taken to reduce methylene-blue declines in a linear fashion when the concentration of spermatozoa is between 683-2,394 million/ejaculate; thereafter the decline is very gradual. But when reduction time is considered in relation to total volume, it has been observed that the methylene-blue reduction time progressively declines when the volume of the ejaculate is from 0.25 ml. to 1.0 ml. The fructose content has been found to bear a linear relation to the total volume.

The various seminal characteristics of the eleven rams used in the trials are presented in Table III. The figures represent the average

TABLE I

Sperm concentration (million/ml.)		Fructose (mg./100ml.)	Fructolysis (in 15 minutes)	MBRT (minutes)
Range	Mean			
0-1999 *(74)	1522 ± 30	818 ± 30	33.3% ± 1.97	35.2 ± 2.39
2000-2499 *(55)	1198 ± 18	773 ± 34	38.8% ± 2.52	22.3 ± 2.57
2500-2999 *(56)	2627 ± 18	726 ± 27	41.2% ± 2.14	20.1 ± 2.19
3000-3499 *(53)	3181 ± 34	633 ± 28	54.9% ± 3.70	13.7 ± 1.44
3500-3999 *(50)	3666 ± 18	651 ± 34	59.2% ± 3.59	12.7 ± 1.01
4000-4499 *(32)	4156 ± 26	633 ± 35	68.5% ± 4.36	12.9 ± 2.29
4500-4999 *(19)	4679 ± 31	590 ± 56	75.1% ± 6.27	8.7 ± 3.18
5000 & above *(14)	5271 ± 89	413 ± 33	90.9% ± 4.28	7.6 ± 1.64

* No. of observations

TABLE II

	Range (ml.)	Mean	Total Fructose (mg.)	Fructolysis	MBRT (mins.)	Average total	
						Volume (ml.)	Sperm (million)
Total volume	0.25-0.50	0.41	3.08	53.3%	27.5	..	91
	0.51-0.75	0.63	3.79	74.2%	16.6	..	2073
	0.76-1.00	0.89	5.48	74.3%	14.3	..	3152
	1.01 & above	1.16	7.46	58.6%	19.6	..	3683
Total sperm per ejaculate (million)	0-1000	683	3.39	40.9%	34.0	0.43	..
	1001-2000	1415	4.32	62.7%	22.1	0.61	..
	2001-3000	2394	4.40	79.6%	12.9	0.73	..
	3001-4000	3471	5.09	81.1%	10.9	0.90	..
	4000 & above	4902	6.20	70.8%	9.1	1.05	..

TABLE III

	1	2	3	4	5	6	7	8	9	10	11
Animal number	..	0.68	0.59	0.70	0.78	0.60	0.61	0.52	0.63	0.94	0.47
Total volume (ml.)	741	477	765	515	351	659	697	838	700	485	774
Fructose (mg./100 ml.)	59.1	75.9	47.7	77	89.1	47.6	35.7	40.5	65.3	75.2	47.9
Fructolysis in 15 minutes (per cent)	..	10.2	11.3	22.8	11.1	8.3	24.1	40.9	25.1	12.3	19.9
MBRT (min. tes)	3542	2973	2567	3392	2987	2264	1930	2677	3235	2657	2546
Sperm concentration (million/ml.)											

values of estimations carried out during 5 months.

The figures reveal interesting individual variations in the various seminal characteristics. The fructose content is low in some animals, although the volume of the ejaculate is high. Animal 5 is a typical example. The rate of fructolysis is much higher in the samples with low fructose content.

Grateful acknowledgement is made to Dr. S. Datta, Director, Indian Veterinary Research Institute, for his kind interest in the work.

A. ROY.

Animal Genetics Section,
Ind. Vet. Res. Institute,
Izatnagar,
December 20, 1949.

S. BHATTACHARYA.
S. N. LUKTKE.
P. BHATTACHARYA.

I. Roy, A., Karnik, Y. R., Luktke, S. N., Bhattacharya, S., and Bhattacharya, P., *Proc. of the 37th Session of the Ind. Sci. Congress* (in press), 1950.

THE MICROBIOLOGY OF INDIGENOUS PICKLES AND PRESERVES

THE growing interest in the preservation of foodstuffs has inspired us to a systematic study of the organisms associated with Indian pickles and other preserves, prepared by indigenous methods. The results are summarized below.

The 102 samples (made from mangoes, guavas, lemons and other fruits and vegetables)

consisted of 13 jams, 3 jellies, 10 morabbas, 23 sweet pickles, 10 sour pickles, 31 pungent pickles and the rest unclassified. Particular attention was paid to the study of proteolytic, amylolytic lipolytic, saccharolytic and cellulolytic activities of the enzymes involved and the interrelationships that existed among the species were also studied. Metabolic products of all the moulds isolated were tested for their antibiotic or the other activities with a view to understand their preservative or other influences. Systematic investigations carried out in this connection indicate that some of the tested condiments can indeed be used as harmless preservatives.

The microbiological analyses resulted in the isolation of 292 bacteria, 13 species of yeasts (*Saccharomyces* 5, *Schizosaccharomyces* 2, *Torula* 4 and *Pichia* 2), 2 species of *Actinomyces* and 70 moulds (54 in vegetative form and 16 in sporulated state). The following organisms or their variants were identified:—*B. subtilis*, *B. pabuli*, *B. laterosporus*, *B. lautus*, *B. mycoides*, *B. terminalis*, *B. coharens*, *B. esterificans*, *B. circulans*, *B. platus*, *B. suprapresistens*, *B. amarus*, *B. tritus*, *B. repens*, *B. novus*, *B. mesentericus*, *B. granularis*, some unidentified members of *Brevis* and *Circulans* groups of aerobic mesophilic bacilli, *M. flavus*, *M. luteus*, *M. rosaceus*, *M. varians*, *M. ochraceus*, *M. epidermidis*, *M. conglomeratus*, *M. ureae*, *M. freudenreichii*, *Serratia marcescens*, *E. coli*, *Actinomyces* *Hipmanni*, *Actinomyces* *griseus*, some species of

Acetobactor, unidentified species of *Sacchardromyces*, *Torula*, *Pichia*, *Schizosaccharomyces*, *Aspergillus*, *Pachytrichum*, *Penicillium*, *Syncephalis*, *Catenularia*, *Prophythroma*, *Syncephalustrum* and *Thamnidium*.

A detailed account of these studies will be published elsewhere.

Microbiology Dept.,
St. Xavier's College,
Bombay,
December 7, 1949.

MADHU RAGHUNATH.
J. V. BHAT.

ANTIBIOTIC PRINCIPLES FROM *MORINGA PTERYGOSPERMA*

Two antibioticly active fractions have been isolated from "pterygospermin" of

The material could however be conveniently fractionated in high vacuum without appreciable loss in activity (Table I).

Fractions 4 and 5 possess very penetrating smell. They do not give any reactions of thiols nor their solutions show any fluorescence in the ultraviolet light. Detailed studies of these fractions are in progress.

Antibiotic Section, P. A. KURUP.
Dept. of Biochemistry, P. L. NARASIMHA RAO,
Ind. Institute of Sci.,
Bangalore,
December 13, 1949.

1. Rao, R., et al., *Ind. J. Med. Res.*, 1949, **37**, (2), 159.

TABLE I
3.8 gms. of Crude oil (35 lbs. of roots)—fractionated at 10⁻³ mm.

Fractions*	Temp. of bath in t° C.	Yield in mgm	Micro-analysis†				Activity against	
			C	H	N %	S	<i>S. aureus</i>	<i>E. coli</i>
1	36-40	98.6					inactive	inactive
2	60-4	47.0					do	do
3	94-5	58.4					do	do
4	125-8	75.8	69.85	7.03	6.40	12.61	1 in 2 × 10 ⁵	1 in 2 × 10 ⁵
					6.44			
5	140-1	212.2	65.00	5.29	7.17	20.46	1 in 4 × 10 ⁵	1 in 4 × 10 ⁵
					6.94	20.32	to 5 × 10 ⁵	to 5 × 10 ⁵
6	Residue	3.0 gm.					inactive	inactive

* Fractions 1 to 5 are colourless mobile liquids.

† By Dr. G. Weiler, Oxford.

Raghunandana Rao, et al.¹ which has been found to be heterogeneous. The antibiotic potency of the crude preparation as assayed against *S. aureus*, was found to vary largely with the age of the plant, and to a certain extent with the season of collection of roots. Complete inhibition was observed at dilutions varying from 1 in 40,000 to 1 in 75,000 with different samples.

Chromatographic methods of fractionation employing adsorbents, viz., charcoal, sugar, tricalcium phosphate, etc., led only to a partial success. With tricalcium phosphate, 240 mg. of crude oil gave (1) 60 mg. of a pale yellow oil from the filtrate (active 1 in 60,000 against *S. aureus*) and (2) a reddish brown oil (170 mg.) recovered from the adsorbate by elution with acetone, which was active only in 1 in 20,000.

LORENTZ-LORENZ EXPRESSION AS AN ANALYTICAL CONSTANT FOR OILS AND FATS

THE importance of refractive index measurements in the analysis of oils and fats is well recognised, but no single property is sufficient to establish the purity of any sample; the reason, of course, is that all natural oils and fats are mixtures, the composition of which varies within fairly wide limits, as a result of which the permitted analytical standard for any particular oil or fat also varies over a wide range.

By making use of the Lorentz-Lorenz formula:

$$\frac{n^2 - 1}{n^2 + 2} \cdot \frac{1}{D}$$

which takes into account two specific properties namely refractive index and density, it was thought the limits of the standard could be brought to a narrower range, and further that

TABLE I
Analytical Data for Mustard Oil

Sample No.	B.R. at 40° C.	I.V.	S.V.	Refr. Index (n)	Density (D)	Specific refraction $\frac{n^2-1}{n^2+2} \cdot \frac{1}{D}$
1	50.45	99.1	172.3	1.46555	0.90384	0.30618
2	60.85	102.1	172.8	1.46645	0.90542	0.30612
3	60.05	100.1	170.5	1.46595	0.90394	0.30621
4	59.35	105.0	172.7	1.4655	0.90425	0.30605
5	59.75	102.9	175.4	1.4658	0.90470	0.30605
6	59.95	104.9	175.0	1.4659	0.90539	0.30586
7	59.85	104.3	173.0	1.4658	0.90527	0.30584
8	60.65	105.7	172.9	1.4663	0.90560	0.30589
9	59.15	100.3	171.9	1.4654	0.90447	0.30581
10	59.85	101.2	173.5	1.4658	0.90490	0.30597
Accepted Standard	58.5 to 60.5	96 to 108	169 to 176			0.30581 Minimum 0.30621 Maximum 0.30600 Average

(Samples 1 to 4 were prepared in the laboratory from different varieties of seeds, while 5 to 10 were bazar samples which were certified as genuine.)

The mean value for the Lorentz-Lorenz formula is 0.30600, and the maximum deviation is ± 0.0002 .

TABLE II
Analytical Data for Groundnut Oil

Sample No.	B. R. at 40° C.	I.V.	S.V.	Refr. Index (n)	Density (D)	Specific Refraction $\frac{n^2-2}{n^2+1} \cdot \frac{1}{D}$
1	56.25	94.5	189.4	1.4634	0.90590	0.30330
2	55.15	92.0	189.3	1.4627	0.90770	0.30330
3	56.25	95.46	190.8	1.4634	0.90895	0.30323
4	56.25	94.5	189.5	1.46345	0.90856	0.30332
Accepted Standard	55 to 57.5	92 to 101	189 to 195			0.30323 Minimum 0.30332 Maximum

The maximum value for specific refraction of mustard oil in Table I is 0.30621 while the minimum is 0.30581, while the range of values for ground nut oil is very much narrower 0.30332 and 0.30323.

TABLE III

(In order to explore the possibility of its use in detecting adulteration, various mixtures were made and the constants determined which are given in Table III.)

Mustard oil	B. R. at 40° C.	I. V.	S. V.	Refr. Index (n)	Density (D)	Specific Refraction $\frac{n^2-1}{n^2+2} \cdot \frac{1}{D}$	Calculated Average decrease for 1%
Pure ..	59.85	104.2	173.5	1.4658	0.90490	0.30597	
+5% ground-nut oil	59.65	103.6	173.8	1.4657	0.9052	0.30583	0.000028
+10% ..	59.45	103.3	174.9	1.46555	0.9053	0.30569	0.000028
+15% ..	59.2	102.3	175.3	1.4654	0.90550	0.30553	0.0000292
+20% ..	59.05	102.3	176.1	1.4653	0.90586	0.30536	0.0000305
+30% ..	58.7	101.2	178.1	1.46505	0.90599	0.30517	0.000027
+40% ..	58.33	100.0	180.0	1.46482	0.90655	0.30485	0.000028
Accepted standard for oil	58.5 to 59.5	96 to 108	169 to 176				

TABLE IV

(Table IV shows the observed specific refraction for various mixtures and the calculated one for the same mixtures making use of average 0.0000283 decrease for 1% groundnut oil.)

Sample	Observed Sp. Refraction	Calculated Sp. Refraction	Difference
Genuine Mustard oil	0.30597	..	..
+ 5% Ground nut oil	0.30583	0.30583	Nil
+ 10% Ground nut oil	0.30569	0.30569	Nil
+ 15% Ground nut oil	0.30553	0.30555	+ 0.00002
+ 20% Ground nut oil	0.30536	0.30541	+ 0.00005
+ 30% Ground nut oil	0.30577	0.30573	+ 0.00004
+ 40% Ground nut oil	0.30485	0.30485	Nil

a quantitative relationship might exist between this constant and the concentration of the adulterant. Both these expectations were realised in the specific cases examined, but obviously more data are required before the limits of standard can be prescribed for general adoption.

In Tables I and II are listed the relevant analytical data for two oils, namely mustard and groundnut, the latter being a common adulterant in the former. Readings for B.R. and density were taken at 40° C. or corrected to this temperature. B.R. : butyro-refractometer reading; I.V. : iodine value; S.V. : saponification value).

A comparison of the figures in Table IV of observed and calculated values shows that the law of additivity is satisfactorily observed implying that a known adulterant can be quantitatively estimated.

The applicability of this principle in detecting adulteration depends upon first prescribing the limits of the standard value. Some idea of this standard may be obtained for mustard oil from Table I last column. With the exception of sample 9 all the rest have values ranging between 0.30584 and 0.30621, with a mean value of 0.30600, the maximum deviation being 0.0002.

If we now turn to Table III it is seen that the specific refraction value for 5% mixture is 0.30583 which is outside the limits but a little close to that of the pure sample; but mixtures of 10% and more adulterant show unmistakably low values away from acceptable standards. At the same time, it must be remembered that the accepted standards for B.R., I.V. and S.V. are such that adulteration even up to 30% cannot be detected by these means.

A full exploitation of the Lorentz-Lorenz expression must await the collection of data for

a very much larger number of samples from different sources.

M. R. NAYAR.

Chemistry Department, S. C. ROY,
Lucknow University, and R. S. SRIVASTAVA,
Public Analyst Department,
U.P. Government, Lucknow,
January 7, 1950.

STUDIES IN HOST-PARASITE RELATIONSHIP IN UNTREATED CHICKS INFECTED WITH *P. GALLINACEUM*

ROEHL¹ used *P. relictum* infections in the canary for a quantitative evaluation of plasmodicidal activity of drugs. Several other methods have since been elaborated by others for a preliminary screening of potential synthetic antimalarial drugs.² An inherent drawback in the use of avian malaria is that the host and the species of the parasite are different from human malaria and the antimalarial activity of a drug may therefore differ markedly from that observed in human infections. Extensive experience of pharmacologists working in this field have, however, shown that this difficulty can be successfully overcome by testing the same drug on two or more hosts infected by different species of parasites. To set up a satisfactory experiment to test the possible antimalarial effect of drugs in laboratory animals requires a critical balance of several factors. The maximum dose of inoculum (of parasites) consistent with reasonable observational safety should be employed in order to provide adequate concentration of parasites in blood and to secure a prolonged survival period of the infected animal.

Using *P. gallinaceum* and young cross bred country chicks (4-10 weeks old), the rate of parasitaemia by blood induced infection was studied. The strain of *P. gallinaceum* was

maintained in adult chicks.³ Donor blood was drawn by cardiac puncture through a hypodermic needle and citrated saline (2% sodium citrate, 0.9% saline) was used as a diluent so that 16 million parasitised red blood cells are contained in each 0.1 c.c. of inoculum. Intramuscular inoculations have been used throughout the present work.

Blood smears were stained with Leishmann and Giemsa stain and parasite counts have been expressed for 500 rbc. Haemoglobin determinations were also made with the aid of Klett-Summerson photo-electric colorimeter (total acid haematin method being used). The galvanometer scale was calibrated for the iron constituent of chick blood and iron determinations were made by the Wong's method.⁴ Using Klett-Summerson's photoelectric colorimeter using filter number 54.

In order to study the rate of Parasitaemia varying doses of parasites five experimental series were studied at different times using the dose of inoculum from 10,000 to 100 million parasites per kilogram of body weight of chick. The following features were observed (Fig. 1). The prepatent period was length-

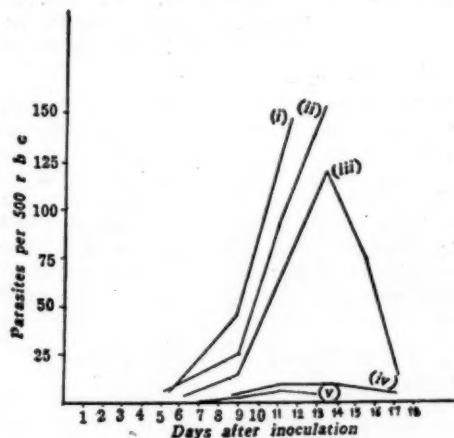


FIG. 1

Dose of parasites per Kg. body weight:—(i) 10^8 , (ii) 10^7 , (iii) 10^6 , (iv) 10^5 , (v) 10^4 .

ened with the lowest dose and the resultant infection was variable and the number of parasites seen in peripheral blood was very low, the parasite count being never more than 5 to 10 per 500 red cells at any time. The latent period was from 7-9 days from the date of infection. As the dose of inoculum was increased to about 1 million or more, the prepatent pe-

riod was considerably shortened the rate of parasitaemia being correspondingly increased.

The percentage of deaths and the day on which death occurs bear a direct relationship to the parasite dose. Ninety per cent. of the birds died on the 100 million and 10 million dose groups, and death occurs within 5-6 days, 50-60 per cent. in 1-2 million and 30-40 per cent. in the 100,000 and 10,000 dose groups. When the inocula containing less than 1 million parasites per kilo of body weight are used, the resultant infections are not constant and neither the peak day of infection nor the degree of parasitaemia can be predicted. The lower dose ranges are therefore not satisfactory for standardising procedures. With an optimal of 1-2 million parasite dose a typical curve is obtained for the rate of parasitaemia which is fairly constant for a large group of birds.

The fall in haemoglobin following different doses in general follows the parasite curve very closely in that the severity of anemia is proportional to the degree of parasitaemia. The iron content of the blood (Fig. 2) shows a sudden

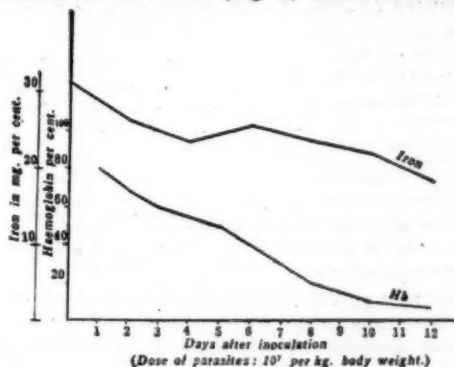


FIG. 2

drop after inoculation and seems to have a temporary rise during the prepatent period. It shows a peak value just on the day before the actual appearances of the parasites in the peripheral blood. This may be due to the prothrombin blood. This may be due to the production of young erythrocytes in larger numbers in the blood stream. It afterwards decreases following very closely the haemoglobin curves.

For the purpose of standardising procedures for subsequent chemotherapeutic studies on untreated infections in chicks infected with different doses of *P. gallinaceum* have been made. Criteria for evaluation of synthetic antimalarial drugs according to Richardson² are (1) Parasite count at the peak of infection, (2) Haemoglobin concentration on the day following the

peak and (3) morphological changes in the parasites. For qualitative studies on the effect of new compounds to be tested a dose of 1-2 million parasites per kilo of body weight of chicks has been found to be adequate. The suppressive antimalarial activity is shown by lowering of the peak of parasitaemia and flattening of the curve with a shift to the right indicating lengthening of incubation period. The higher doses produce higher rates of mortality and may vitiate the test. Haemoglobin and iron content of blood is particularly of interest as an ancillary evidence of the multiplication of parasites before the actual appearance of parasites in the peripheral blood and of the consumption of the hosts, haemoglobin by the growing parasites.

Authors' thanks are due to Dr. K. P. Menon for his keen interest and helpful suggestions.

V. R. SRINIVASAN.
V. RAMAMURTHY.
A. S. RAMASWAMY.
R. RAMA RAO.
N. N. DE.

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ON SAMPLING STUDIES IN THE ESTIMATION OF WHITE FLY INCIDENCE ON SUGARCANE

THE aim of the present note has been to see, if the sampling procedure recommended earlier¹ could be used in estimating the incidence in other whitefly infested fields. The efficacy of

the sampling procedure has been judged on the basis of consistency of the distribution of the errors in the different fields.

An 1/40 acre plot (6 rows \times 20 units) was marked out at random in each of the four fields infested with whitefly at Motihari (Baria Farm) and 15 random units in each plot were completely enumerated, counting all clumps, canes, leaves (dry and green) and the puparia in each affected leaf. Table I given below shows these details.

As there was no sufficient choice of randomisation of clumps in units and canes in clumps, all clumps and canes with five affected leaves per cane were included in the sample for the estimation of the zone variances (units, clumps, canes and leaves being defined as the successive zones).

In the original paper,¹ analysis of variance was done with logarithmic transformation after multiplying each incidence figure by 100, and it was observed that transformation was not essential for the purpose of analysis. Here also, the analysis has been done with the incidence figure as such as also with a similar transformation of the variate. The estimates of the zone variances and these variances expressed as percentages of the total variation are given in the Table II below.

It is noticed that here also the leaves take away by far the largest percentage of variation under both the analyses and that there is also a distinct similarity in the distribution of the percentage variations in the other zones. The conclusion drawn before is therefore confirmed; viz., "the advantage accruing from the transformation is not of such a high order as to offset the extra inconvenience encountered in

TABLE I

Showing total no. of units, clumps, canes leaves, (dry and green) and the percentage of affected leaves

	Plot I	Plot II	Plot III	Plot IV
No. of units	15	15	15	15
No. of clumps	37	41	33	41
No. of canes	92	108	95	92
No. of green leaves	1,046	1,131	1,078	1,009
No. of dry leaves	571	731	735	675
No. of affected green leaves	687	853	746	747
No. of affected dry leaves	115	292	324	243
percentage of affected green leaves on the basis of total green leaves	65.68	75.42	69.20	74.03
percentage of affected leaves on the basis of total leaves	49.67	61.43	59.92	58.10
Mean puparia per sq. inch (sample)	3.29 \pm 0.29	3.15 \pm 0.25	2.64 \pm 0.32	3.11 \pm 0.27

TABLE II

Showing variances due to different zones and percentage errors

	Mean \pm S.E.	S.E. expressed as % mean	Actual zone variance				Zone variances expressed as % of total			
			σ_1^2	σ_2^2	σ_3^2	σ_4^2	σ_1^2	σ_2^2	σ_3^2	σ_4^2
Plot I	.. 3.29 \pm 0.29	8.90	0.8202	0.0964	1.2000	4.3000	12.78	1.50	18.70	67.02
	2.36 \pm 0.05	2.12	0.0257	0.0020	0.0291	0.1250	14.14	1.10	16.00	68.76
Plot II	.. 3.15 \pm 0.25	7.96	0.6708	0.1065	0.0020	5.4900	10.70	1.70	0.03	87.57
	2.33 \pm 0.04	1.82	0.0106	0.0036	0.0134	0.1600	8.57	1.86	6.92	82.65
Plot III	.. 2.64 \pm 0.28	10.60	0.5689	0.6079	0.1500	4.4300	9.88	10.56	2.61	76.95
	2.19 \pm 0.06	2.78	0.0399	0	0.0345	0.1975	14.67	0	12.60	72.64
Plot IV	.. 3.11 \pm 0.27	8.67	0.6764	0.1620	0.4180	6.4200	8.81	2.11	5.44	83.64
	2.31 \pm 0.04	1.68	0.0135	0.0037	0	0.1942	6.39	1.75	0	91.86

The lower figs. have been obtained from the analysis after logarithmic transformation

handling the transformed material". The percentage errors in the four plots (under the analysis without transformation) vary from 7.96 to 10.60. The errors in plots (1), (2) and (4) are 8.90, 7.96 and 8.67, which may, however be reckoned to be of the same order for all practical purposes.

From a comparative study of the percentage errors obtained now and those noticed before, it may be said that the recommended sampling procedure has given more or less a steady estimate of the error percentage, showing thereby the suitability of the sampling procedure for all practical purposes. Further studies on the sampling procedure under severe and low infestation are in progress.

The work was carried out as part of the Sugarcane Research Scheme financed jointly by Bihar Government and the Indian Central Sugarcane Committee to whom grateful thanks are due. Part assistance rendered by Mr. R. C. Acharya in the reduction and analysis of the data is also acknowledged.

K. L. KHANNA.

K. S. BANDYOPADHYAY.

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December 19, 1949.

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ON "MORELLIN" THE ANTIBACTERIAL PRINCIPLE OF THE SEEDS OF *GARCINIA MORELLA* DESROUX

The isolation from the pericarp of *Garcinia morella*, of a crystalline compound "morellin" and an amorphous waxy material has been

reported but no work appears to have been done on the antibacterial principles of the plant. The authors have found that the alcoholic extracts of the seed exhibit marked antibiotic activity when tested by the cup-plate method against *B. subtilis*, the seat of the antibiotic principle being the yellow pigment of the pericarp. On isolation, the crystalline compound was found to be highly antibacterial while the waxy substance was practically inactive.

The antibacterial spectrum of morellin was determined by inoculating 0.01 c.c. of 24-hour broth culture of the test organisms, to tubes containing sterile nutrient broth at pH 7 and morellin at different concentrations,* the volume of total broth in each tube being 5 c.c. The growth of the organisms was observed visually after 18 hours incubation at 37° C. The results are shown in Table I.

TABLE I

Antibacterial spectrum of morellin

Name of organism	Dilution of morellin in broth				Growth in control
	1/75,000	1/100,000	1/150,000	1/200,000	
1 <i>S. aureus</i>	..	-	-	-	+++
2 <i>B. subtilis</i>	..	-	-	-	+++
3 <i>E. coli</i>	..	+	+	+	+++
4 <i>B. typhosus</i>	..	-	-	-	+++
5 <i>B. paratyphosus B</i>	..	+	+	+	+++
6 <i>B. paratyphosus C</i>	..	-	-	-	+++
7 <i>B. dysenterica</i>	..	-	-	-	+++
8 <i>B. entortidis</i>	..	-	-	-	+++
9 <i>B. aerogenes</i>	..	-	-	-	+++

In the table—indicates no growth; + indicates growth

Results presented above clearly show that at concentrations of about $10 \mu\text{g}$ per c.c., morellin completely inhibits the growth of the micro-organisms and partially at lower concentrations.

The pronounced antibacterial properties exhibited *in vitro* by morellin encouraged us to study the toxicity of the drug to mice by a method previously described² for finding the toxicity of allicin and pterygospermin. Alcoholic solutions (60% alcohol) of morellin were used. To groups of six mice each, doses ranging from 25 mg. per kg. to 200 mg. per kg. were injected subcutaneously. There was considerable necrosis at the site of injection in all the animals, resulting ultimately in death within ten days.

Even at considerably smaller doses such as 2.0 mg. to 4.0 mg. per kg., necrosis of the tissues develops at the site of injection from the fifth day. Morellin thus appears to be highly toxic, and is therefore not likely to assume any importance in chemotherapy.

Our thanks are due to Drs. N. N. De, K. P. Menon and P. L. N. Rao for their suggestions, and Mr. B. N. Banerjee for his interest in these investigations.

Pharmacology Lab. R. RAGHUNANDANA RAO.
Ind. Inst. of Sci., S. NATARAJAN.
Bangalore 3,
February 6, 1950.

* Though morellin has been reported to be highly insoluble in water, practically clear solutions of the drug in nutrient broth could be obtained at the concentrations used for the studies. The use of the serial dilution method for determining the antibacterial spectrum was thus possible.

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ACTIVE RELAXATION OF UNSTRIATED MUSCLE DURING INHIBITION PRODUCED BY ADRENALINE

SINGH (1944) and Singh and Singh (1946, 1949 a) have described active relaxation of frog's unstriated muscle; Singh, Singh and Muthana (1947) of fowl's gut; and Singh and Singh (1948, 1949 b) of dog's stomach muscle and the human appendix. It has been further found that relaxation of frog's stomach muscle during inhibition produced by adrenaline (1 in 100,000) is active.

The following experimental procedure is used. Transverse pieces of muscle from the cardiac half of frog's stomach are soaked in saline of pH 6.5 for one hour. This acid saline

is used to prevent decomposition of adrenaline and to diminish tone which is antagonistic to active relaxation (Singh and Singh, 1949 b). The muscles are then placed unloaded in a trough containing the saline and their lengths measured. Adrenaline is then added to the saline, and the lengths recorded every 5-15 minutes for one hour.

The muscles begin to actively elongate immediately on addition of adrenaline. Within 5 to 10 minutes they elongate by about 90 p.c., though they further slowly elongate till about one hour, after which they may begin to shorten. The results are shown in Table I. The

TABLE I

Experiment ..	1	2	3	4	5	6	7	8	9	10
Length in saline	21	20	15	15	16	17	16	17	24	22
n.m.										
Length in	26	23	17	17	20	22	22	21	26	29
adrenaline 1:100,000 mm.										

muscle may elongate up to about 140 p.c. of its initial length.

Physiological Lab., SUNITA Inderjit Singh.
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INHERITANCE OF SPARSE LINT MUTANT IN COCONADAS COTTON

A NEW instance of major gene control affecting lint quantity is reported here as supplement to the other genes in Cocanadas cotton described elsewhere.^{1,2}

During a survey of the Coconada area (*G. arboreum* race *indicum* H.), two different lint quantity genotypes designated as '1711' and 'CST 1' were spotted and found to breed true. The former possessed a combed length of 10 to 15 mm. and a ginning outturn of 3 to 4% while the latter registered means of 5 to 10 mm. and 6 to 9% for the respective characters. Visual examination of the two types brought out the same differences more clearly. '1711' had sparse lint on an underlying thin coat of fuzz while 'CST 1' had comparatively a denser coat of both lint and fuzz as might be seen from Fig. 1.

The lint samples of '1711' and 'CST 1' did not lend themselves to technological determinations of mean staple length by Ball's sorter or mean

Lint quantity attributes: Mean Values.

Type	Lint length in mm.	Ginning %	Lint index (wt. of lint in gm. borne on 100 seeds)	Weight of 10 seeds in gms.	Volume of liquid dis- placed by 10 seeds	Weight of lint* borne on x seeds in gm. after ad- justing* for size	Remarks
45	.. 22.0	24.0	1.199	0.43	0.33 c.c.	0.1370	Normal lint
1711	.. 10-15	3.6	0.195	0.45	0.40 c.c.	0.0195	Sparse lint
CST 1	.. 5-10	6.9	0.249	0.39	0.30 c.c.	0.0332	Short lint
CST 4	.. 16.0	6.0	0.259	0.24	0.38 c.c.	0.0273	Immature lint

* Weight of lint borne on x number of seeds reduced to a common seed size unit, i.e., seed size equivalent to a volume of 0.4 c.c. of displaced liquid.

fibre weight per unit length. In feel by hand, there was no difference between the two and another new addition to old world cotton group from the highly variable Coconada centre.

R. BALASUBRAHMANYAN.

Agricultural College V. SANTHANAM.
and Research Institute,
Coimbatore,
December 5, 1949.



FIG. 1

hence their fibre weights might be presumed to be the same. The lint quantity values of '1711', normal linted strain 45 and two other mutants, viz., 'CST 1' and 'CST 4', found in the same area are furnished in Table I after reducing them to a common seed size group. The values of the three mutants are on the low side due to existence of major differences in fibre properties like density, staple length and maturity but not in seed weight. Consequently conclusions based on ginning per cent will be equally valid for lint index. On an *a priori* basis, it would be justifiable to call '1711' 'sparse-lint' being the lower of the two and to name 'CST 1' 'short lint' on account of its higher density and shorter length.

The segregation obtained in the cross, '1711' 'sparse lint' with normal '45' was monofactorial for ginning per cent giving 85 normal and 24 'sparse lint' in the F_2 . Other instances of monogenic behaviour in lint quantity are 'no lint' (0-10% ginning) and 'Scant lint' reported in upland cotton.^{3,4} The character 'sparse lint' now assigned the gene symbol li_p is yet

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POLYCARPY IN *CICER ARIETINUM*

In *Cicer arietinum* Linn. polycarpellary flowers were noticed at Kanpur in a local variety 3-1, which is one of the segregates, of a cross between Local Type 1 and N.P. Type 82. It is a tall, erect growing late variety with dark green foliage and possessing large, brown, round and bold seeds. Generally it bears double-flowered pedicels but variations from one to three-flowered pedicels were also noticed.

In most of the double-flowered pedicels the lower flower is the abnormal one. The colour of the flower-stalk remains greenish throughout. The abnormal flower buds appear later than the normal ones and expose their sexual organs very early. The sepals increase in number upto 9 and become petaloid to some extent. The petals also increase in number upto seven and give a shabby appearance to the flowers due to their malformation. Stamens have been noticed to have increased upto 16 in number and present a poly-adelphous con-

dition. Tricarpellary and penta-carpellary apocarpous pistil (Fig. 1) were observed.



The appearance of more than one free carpel in this genus is of interest. It supports the view that the evolution in Rosales has taken place by the reduction in the number of carpels and appearance of Zygomorphy.

More than one carpel are often met with in the sub-family mimosoideae. Cases have been recorded in the subfamily Caesalpinioidy-*Poinciana regia* Boj. (Joshi, 1932) and *Saraca indica* Linn. (Krishnamurti, 1931).

Govt. Agricultural College, K. N. KAUL.
Kanpur, M. S. SOLANKI.
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NATURAL HYBRIDS IN ARACHIS NAMBYQUARAE

Arachis nambyquaræ (acclimatized in Bangalore since 1932) has been found to cross freely with the cultivated varieties of *Arachis hypogaea*. Attempts to isolate strains from these crosses of agronomic and commercial importance have not so far been successful.

During 1942, two plants were observed in *Arachis nambyquaræ* plots at the Central Farm at Hebbal, which appear to be natural hybrids. The plants had erect habit; one of them was compact, the other was loose. The pods were prominently veined with a pronounced beak, that of the compact plant bearing 3 seeded pods while the other had only two. The kernels were slightly cylindrical and coloured like *nambyquaræ* with brown interspersed with white bands and streaks. In the latter, in addition to this white splash, a dilute purple wash has been superimposed. This colouration of the testa has not been observed in any

of the various crosses under observation here. The inheritance of this character is under investigation.

Agri. Res. Institute, T. SRINIVASA MURTHY.
Hebbal, K. GOPALA IYENGAR.
December 6, 1949.

FOAM DISEASE OF CITRUS IN ASSAM

TREES of Khasi orange (*Citrus reticulata* Blanco.) older than 5 or 6 years have recently been affected by the malady known in Assam as the "foam" or "weeping" disease. The disease has been noticed only on Khasi orange and not on any other species or varieties of citrus.

Symptoms.—The characteristic symptom is the exudation of white foam or froth from longitudinal cracks in the bark of the trunk at ground upto a foot or a little more above the ground level (Fig. 1). These are commonly



FIG. 1. Foam Disease of Khasi orange. Early stage. Exudation of foam in longitudinal streak shown within inset.

1 to 12 cm. in length and 3 to 10 mm. in width. All branches are affected, but not as frequently as the trunk. The lesions in a single tree vary from one to many. The bark rots, while the wood beneath emits a characteristic disagreeable odour and turns slightly brown. They

are infested by Nitidulid beetles attracted probably by the odour. Microscopical examination shows that the white exuded foam is a mass of yeast cells and mycelia of fungi.

The symptoms start in June with the rains, and continue till September. With the approach of the cold weather, the foam disappears and the lacerated bark peels off exposing the dead wood underneath (Fig. 2).



FIG. 2. foam disease of knasi orange. Exposure of dead wood after the peeling off of the diseased bark shown by arrows.

Direct injury results from the gradual increase of the lesions, finally resulting in the complete girdling of the trunk or branch. Through the lesions, insect borers and other destructive agents make their entry while fruit production is lessened and plant life shortened. The disease progresses slowly compared to other citrus diseases, but the damage is no less serious.

Cause.—So far, it has not been possible to determine the cause of the disease. Diseased materials show that species of *Fusarium*, *Phytophthora*, *Botrytis* and *Aspergillus* are common. Infection experiments carried out with pure cultures singly or in combination have so far been inconclusive. It was, however, observed that plants growing on the foot-hills and on ill-drained soils are more susceptible than the others.

Similar outbreaks under the name of 'foam' or 'bark rot' have also been reported from Dutch East Indies by Van der Goot (1928) and Leefmans (1929), from Java by De Vries (1928), from Philippines by Lee (1923) and Morada (1930) and from California by Fawcett (1936). But it has not been possible to identify this malady with any in these countries. Muller, writing from Java, [reported by Fawcett (1936)] suggests that the outbreak in Java was influenced by the extremely dry east monsoon of 1925, just as the outbreak in the Philippines and Southern China was preceded by the drought of 1911. Toxopneustes [reported by Fawcett (1936)] also writes that in Java the disease occurs especially in the lowland and only in those regions where the trees suffer from drought.

Treatment.—As the disease is a serious one in Assam, experiments were carried out to arrest its virulence. It was found that a coating of Bordeaux paste on the affected bark after scraping checked the further extension of the disease and stopped the exudation of the foam completely. No exudation of foam issues from these lesions subsequently, although new lesions may develop elsewhere in the same trunk or branch.

A detailed report of the extensive investigations in progress will appear in due course.

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October 19, 1949.

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WILT OF CASUARINA

A WILT disease of *Casuarina equisetifolia* was recorded from Ganjam by Butler in 1905 and from Mauritius by Shepherd (1928). *Trichosporium vesiculosum* Butl. had been observed on many of the affected trees but its pathogenicity had not been proved. It was considered that it might be a follower of some other root parasite (Anon, 1923).

A similar disease has been observed over a number of years in the casuarina plantations in Nellore, South Arcot, Tanjore and Tinnevely districts. The same fungus was noticed on a number of dead plants. In a few specimens *Diplodia* sp. was isolated from the roots. The

opinion is prevalent among some of the members of the forest and agricultural departments that the casualties among the casuarina plants are more due to either excess of water or lack of it and not due to any definite pathogen.



FIG. 1. Casuarina artificially infected showing black mass of spores beneath the bark.

To determine the role of *Trichosporium vesiculosum* in bringing about the death of casuarina, investigations were commenced towards the end of 1948 at Coimbatore. The Conservator of Forests, Ootacamund, kindly arranged for the supply of sufficient quantity of fresh spores of the fungus from Nellore. These readily germinated and pure cultures of the fungus were obtained from single spores. There was luxuriant growth and sporulation on potato dextrose and oat agars.

The pure culture was utilised for inoculating casuarina trees four to six years old growing

in the pot culture house. The inoculum was placed under the bark near the ground level and bound up with wax cloth. Controls were kept.

Two months later the seat of inoculation had turned slightly brown and a few spores had formed in some of the fissures. Yet there was no symptom of wilt. Six months later the inoculated trees began to wither and in another two months they were completely dead with the bark ruptured and large quantities of the black spore powder were observed under the bark. The formation of spores was evident in some, at the base and in others in the upper portions of the stem. All the six inoculated trees died while all the controls are still healthy.

It is thus established that *Trichosporium vesiculosum* is pathogenic on casuarina and it causes the wilting, drying and ultimate death of the plant. It is a wound parasite and in nature, casuarina bark exhibits rupturing. These may serve as places of entry.

Isolation of diseased patches by trenches has been recommended for arresting the progress of the disease in plantations. The profuse spore formation on dead trees results in air-borne infection. Consequently trenching may not be effective.

Agri. Res. Institute,
Lawley Road P.O.,
Coimbatore,
November 16, 1949.

D. MARUDARAJAN.
T. S. RAMAKRISHNAN.
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NOTE ON *OROBANCHE CERNUA* LOEFL.

Orobanche cernua var. *desertorum* is a common root parasite on tobacco causing a 'near-wilt' appearance of the plant in the field and affecting the yield and the quality of the leaves. This disease was investigated for five years at Guntur and some of the results are here recorded.

In this province *Orobanche cernua* has been found to parasitise a number of host plants, viz., *Datura fastuosa* (purple), *D. fastuosa* var. *alba*, *D. stramonium*, *Lycopersicon esculentum*, *Nicandra physaloides*, *Nicotiana affinis*, *N. glauca*, *N. glutinosa*, *N. rustica*, *N. sandarac*, *N. tabacum*, *Petunia* sp., *Physalis minima*, *Solanum melongena*, *S. nigrum*, *S. tuberosum*, *S. xanthocarpum*, *Withania somnifera*, *Helianthus* spp., *Carthamus tinctorius*, *Acalypha indica*, *Euphorbia prostrata*, *Corchorus capsularis*, *C. trilobularis*

and *Cannabis sativa*. Special mention has to be made of *Datura fastuosa* var. *alba* which is easily and heavily parasitized by *Orobanchae*. In one plant the formation of nearly 500 nodules (places of infection) was noticed on the roots. Some other hosts have been found to stimulate the germination of *Orobanchae* seeds without being parasitized themselves. In this category are included *Capsicum annum*, *Tridax procumbens* and *Bidens pilosa*; 13 to 15% of the seeds germinated close to the roots of these plants but there was no development of any haustorial connection. The behaviour of the parasite towards *Capsicum* deserves special attention. This crop plant can be grown in rotation with tobacco and preceding it in order to reduce the infection from the soil. A large number of the seeds may thus be made to germinate and die out for want of a suitable host.

Garmen (1903) found that the seeds remained viable for 13 years in the soil. The experiments conducted at Guntur have shown, however, that the seeds of *Orobanchae cernua* do not remain viable for over 2½ years either in the soil or when stored in stoppered containers in the laboratory.



FIG. 1. *Datura fastuosa* var. *alba*, infested by *Orobanchae cernua*.

Cattle and goats freely feed on *Orobanchae* shoots. The voids were later collected and applied to soil in pots with tobacco plants. *Orobanchae* shoots developed indicating thereby that

the seeds pass through the alimentary canal without damage and remain viable. The indiscriminate grazing of such animals in the field is thus a source of disseminating the seeds of the parasite.

The seeds soaked in water for one month lose their viability as compared to the dry ones.

A long rotation with tobacco grown once in 3 years and preceded by a chilli crop will save the huge losses due to the ravages of this parasite, especially in Virginian tobacco.

Agri. Research Institute, D. MARUDARAJAN.
Lawley Road P.O.,
Coimbatore,
November 16, 1949.

I. Garmen, H., "The broom rapes," *Kentucky Agri. Expt. Sta. Bull.*, 1903, 105.

A NEW ROOT-ROT DISEASE OF *CYPERUS* SPP.

A ROOT-ROT disease of *Cyperus papyrus* Linn., *Cyperus alternifolius* Linn., and *Cyperus eleusinoides* Kunth. was observed at Nagpur during December 1947. The plants affected were all six months old. On culturing, the underground parts of the affected plants yielded *Pythium intermedium* de Bary not so far reported on any species of *Cyperus*.

The disease is indicated by the general paleness of the leaves and stems. The leaves then begin to dry up from tip inwards, extending later to the stem. The underground parts of the affected plants turn dark brown and dry, the mycelium of the organism being found in all the tissues. Sporangia are also sometimes found inside the host tissues, mostly in the cortical cells of the roots.

On rice-meal agar, the isolated organism produces abundant mycelium and sporangia. The hyphae are colourless, highly granular, laterally or dichotomously branched and uniformly thick, measuring 0.6 to 6 μ in width. They are coenocytic when young, but with age become septate. In some cultures a few of the hyphae are found to bear typical finger-like swollen bodies. These bodies may become active and give rise to new hyphae. The sporangia are borne singly or in chains. There are upto 21 sporangia in a single chain. They are spherical or pear-shaped, measuring 6.9 to 21.4 μ in diameter (average 15.5 μ). In the chain, the spherical sporangia are usually separated from each other by cylindrical stalks which are 0.5 to 4.4 μ along and 2.9 to 4 μ across the axis. The sporangia readily germinate in fresh water either by zoospores or by germ-tubes. The

tube of discharge, which swells out into a thin-walled vesicle, is about $5\ \mu$ in length. It appears in all positions, most frequently laterally. The zoospores formed inside the vesicle are reniform and biciliate. The organism may therefore be identified with *Pythium intermedium* de Bary.

Tests for its pathogenicity were carried out on autoclaved soil in pots. The organism proved non-pathogenic on all the three species of *Cyperus* from which it was originally isolated.

My thanks are due to Dr. R. P. Asthana, Mycologist to Government, C.P. & Berar, for the facilities accorded for work.

Agri. Res. Institute,

K. A. MAHMUD.

Nagpur,

January 13, 1950.

COLCHICINE INDUCED POLYPLOIDY IN SPINACH

THE results obtained by various workers so far^{2,4,5,6} indicate that the response of crops in terms of fruits or seeds to colchicine treatment is not promising. But it has been found that this treatment leads to increased vegetative growth. The effect of colchicine on Spinach commonly used as a leafy vegetable was tried, and a preliminary report of the results is given here.



Pollen meiosis in the diploid and the tetraploid showing anaphase I ($\times 1500$).

The most successful treatment for the production of polyploids was found to be 0.10% colchicine applied to the growing point for 12 hours. The immediate noticeable effect of the colchicine treatment was a temporary arrest of growth. The first four leaves in the treated plants were thicker and smaller as compared to the control. Later leaves, however, were not as thick nor was there any marked difference in the size except that they were a little broader. The treated plants were characterised by larger stomata, lesser number of stomata per unit area, bigger pollen grains, and lateness in flowering and maturity. There was consi-

derable variability in the size and sterility (15-40%) of the pollen grains of the colchicine treated plants. There were no differences in fruit size and fruit setting of the treated and the untreated plants. Meiosis was studied and the chromosome counts at anaphase I of the diploid and the colchicine treated plants confirmed the diploid number ($2x = 12$) and the tetraploid number ($4 = 24$) as previously reported^{1,3} (Fig. 1).

The stomata, the pollen grain size and the temporary acetocarmine smears of pollen mother cells were used as criteria for the selection of polyploids. A large amount of variability in vegetative and other characters in the colchicine treated population indicates the possibility of selection for an improved type. Further work is in progress.

I am thankful to Dr. J. J. Chinoy, Department of Botany, University of Delhi, for his guidance in the work and helpful suggestions.

Department of Botany,

S. L. TANDON.

University of Delhi,

Delhi,

January 3, 1950.

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THE pH TOLERANCE OF AN AQUATIC PLANT COMMUNITY

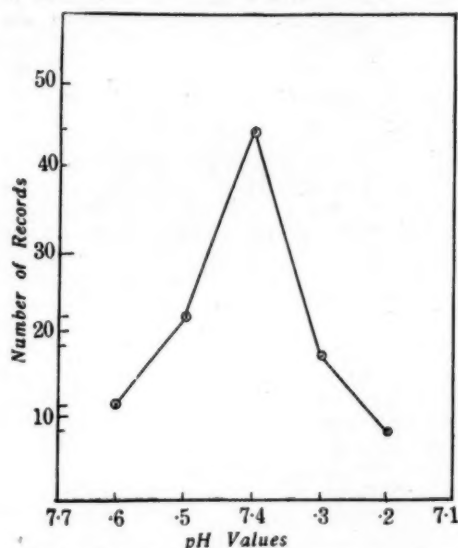
SOIL samples supporting a community of *Hydrilla*, *Vallisneria* and *Potamogeton* from rivers, ponds, and pools at Allahabad, were collected to assess the pH tolerance of this aquatic community.^{1,2,3,4}

The samples were taken at root and the hydrogen-ion concentration was measured by means of B.D.H. Hellige comparator.

The following table gives the various classes of pH values of the soil, the number of records and the percentage number of the total soil samples examined on which the above noted vegetation grows luxuriantly:—

pH classes						
pH values	..	7.2	7.3	7.4	7.5	7.6
No. of records	..	8	18	44	22	11
% of total soil samples		7.8	17.4	42.8	21.4	10.6

The same values are plotted in the following figure:



The graph approximates to normal unimodal variation curve, as pointed out by Pearsall.²

The tolerance of pH values of the community, consisting of *Hydrilla*, *Potamogeton* and *Valisneria*, lies between 7.2-7.6, with the optimum at 7.4. This shows the community's preference for a slightly alkaline soil.

Grateful thanks are due to Prof. S. Ranjan for many suggestions and encouragement.

GIRJA DAYAL SRIVASTAVA.

Botany Department,
University of Allahabad,
January 10, 1950.

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DAMPING-OFF OF CABBAGE, CAULIFLOWER AND KNOLKOH CAUSED BY *PYTHIUM APHANIDER- MATUM* (EDS.) FITZ.

A DAMPING-OFF of cabbage (*Brassica oleracea* L. var. *capitata*), cauliflower (*Brassica oleracea* L. var. *botrytis*) and knolkohl (*Brassica oleracea* L. var. *caulorapa*) was observed at

Nagpur during October, 1948. On culturing the affected seedlings yielded *Pythium aphanidermatum* (Eds.) Fitz. The above species of *Pythium* has not so far been reported on any variety of *Brassica oleracea*.

The first indication of the disease is the yellowish discolouration of the hypocotyl at the ground level. The discoloured part softens and rots and occasionally becomes constricted. The affected seedling ultimately topples over and dries up. The hyphae of the pathogen are present in all the affected tissues. They are chiefly intercellular.

The organisms isolated from the cabbage, cauliflower and knolkohl seedlings were all found to be identical. On rice-meal agar, the organism develops a white dense cottony growth. After six or seven days the whole of this fluffy growth subsides and becomes matted on the surface of the medium. The mycelium is colourless, highly granular, profusely branched and 1.1 to 8.6 μ in width (average 3.2 μ). It is coenocytic at first, but with age becomes septate here and there. In some cultures the mycelium produces typically falcate structures (Fig. 1). The oogonia are terminal, smooth and spherical, measuring 15.2 to 28.5 μ in diameter (average 20.7 μ). The antheridia are terminal or intercalary. They are usually monoclinalous and occasionally declinalous (Figs. 2 to 4). Usually one, and in rare cases two antheridia are appressed against a single oogonium. They are broadly club or barrel-shaped, measuring 4.4 to 8.3 μ in width (average 6.6 μ) and 6.7 to 13.2 μ in length (average 10.3 μ). The oospores are spherical, smooth and thick-walled, measuring 14.1 to 19.2 μ in diameter (average 15.3 μ). The walls of the oospores are 1.5 to 3 μ in thickness (average 2.1 μ). The sporangia are more numerous in water cultures than in agar media. They are terminal or intercalary, simple or digitately branched lobulate structures, varying in shape and size (Figs. 5 to 8). The rupture of the sporangial wall occurs at the apex or at the tip of one of the side branches, followed by the formation of a thin-walled vesicle. The content of the sporangium flows into the vesicle and becomes segmented into reniform, biciliate zoospores. The zoospores are 9 to 17 by 5.7 to 8 μ in size (average 12 by 7.5 μ).

The pathogenicity of the isolated organism from cabbage, cauliflower and knolkohl was tested on autoclaved soil in pots. The first case of damping-off occurred when the seedlings were 3 days old and the last when they were 17 days old. There was no mortality in any of

the control pots. The organism was reisolated from the affected seedlings. The isolates from

My sincerest thanks are due to Dr. R. P. Asthana, Mycologist to Government, C.P. &

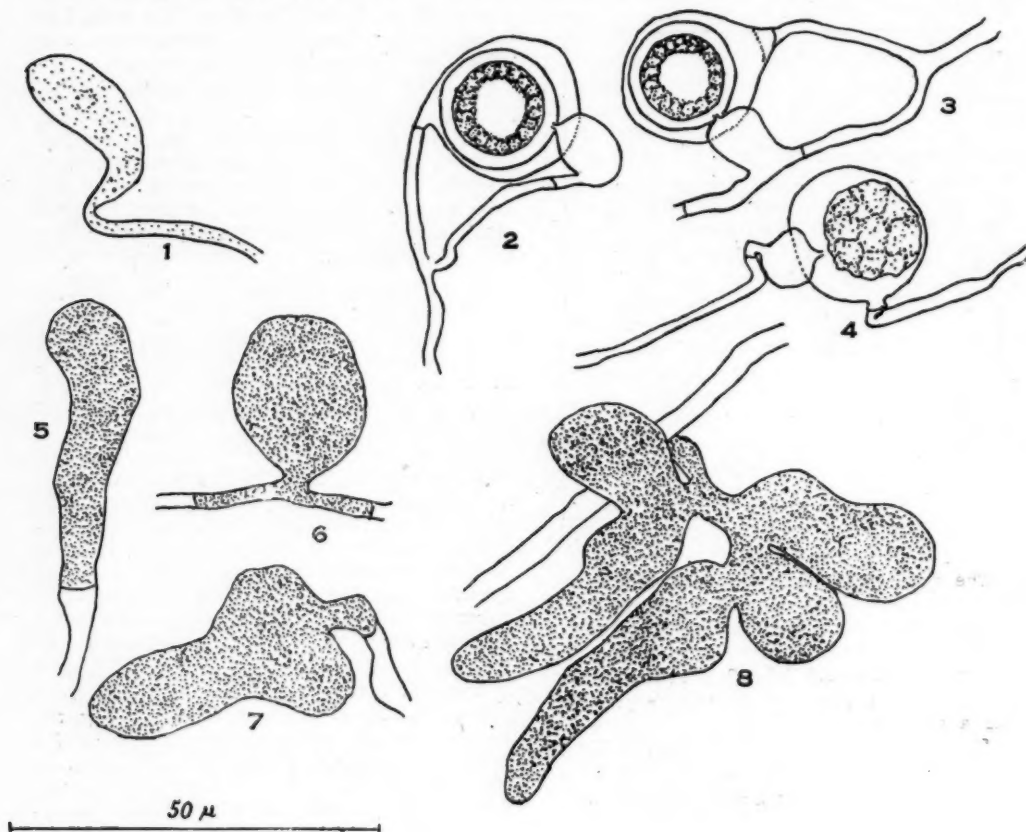


FIG. 1. Falcate structure. FIGS. 2, 3 and 4. Antheridia, oogonia and oospores.

FIGS. 5, 6, 7 and 8. Sporangia.

cabbage, cauliflower and knolkohl were similar in their pathogenicity to cabbage, cauliflower and knolkohl, being more virulent on cauliflower than on cabbage or knolkohl.

Berar, for the facilities accorded for the study. Agri. Research Institute, K. A. MAHMUD. Nagpur, December 17, 1949.

ERRATUM

Curr. Sci., 1950, 19, p. 16, note on "Fluorescent Indicators for Acid-base Titrations," in Table

s. No. 7, read 6.1—8.1 for 3.1—8.1 under pH range.

REVIEWS

Recent Progress in Hormone Research, Vol. IV. Edited by Gregory Pincus, 1949. (Academic Press Inc., New York, N.Y.), Pp. 529. Price \$8.00.

The Laurentian Hormone Conference held at Franconia, New Hampshire, in September 1948, attracted many eminent investigators in hormone research in U.S.A., Canada and U.K. The outstanding contributions presented therein and the illuminating and critical discussions which followed them are now published as Volume IV of *Recent Progress in Hormone Research*.

The book is divided into four sections and commences with steroid hormone metabolism *in vivo* and *in vitro*. Some aspects of metabolism of estrogen have been emphasised and a critical general survey designed to promote discussion is presented in Chapters 2 and 3. The role of the liver in estrogen metabolism has been discussed in detail and there seems to be general agreement that the inactivation is enzymatic and that it occurs mainly in the liver. Rat liver slices are capable of inactivating α -estradiol but when the ability of liver slices is compared with that of mince prepared from the same liver, it is noted that the liver mince inactivated more variably and to a much lesser extent than did the slices. This suggests that one of the participating enzymes or co-enzymes is unstable in a broken cell preparation and might be enzyme labile.

Progress in our knowledge of the role of hormones in tissue and body metabolism has been very rapid during recent years, and Section II is concerned with anti-hormone problem in endocrine therapy; integration of the effects of adrenal cortical, thyroid and growth hormone in fasting metabolism; alteration in metabolism incident to administration of insulin, adrenalin and thyroid substances studied with the aid of isotopes and the metabolic changes in man following adrenal and pituitary hormone administration. Section III deals with neurohumoral-hypothalamic relationship and the chapters on adrenal function in mental disease; manifestation of altered autonomic and humoral function in psychoneuroses; and the effects of hypothalamic lesion on water and energy metabolism in the rat are very interesting. The role of the hypothalamus in neurohumoral relationship was not clearly understood

for many years, but with recent progress in experimental technique we are beginning to understand the relationship more clearly. In Section IV, the physiology and function of thyroid are discussed. Dealing with physiologic reactions of thyroid stimulating hormone, Rawson and Money limit their discussion to: (a) factors and conditions which influence the production and release of this hormone by the anterior pituitary, (b) primary action of the hormone, (c) a possible mode of action and (d) factors which influence this hormone action on the thyroid. The chapter on the metabolism of iodine in man as disclosed through the use of radioiodine is of importance. The tracer technique, despite complexities and limitations, possesses advantages which are particularly applicable to studies of human subject, and provides new data of a dynamic nature not accessible by the older methods. Radioiodine has also been widely used in clinical medicine as a diagnostic and therapeutic tool, and Seidlin has summarised the work done in this direction and emphasises clinical application and physiological aspects of this type of therapy.

The volume under review contains a number of articles by scientists engaged in active research in the fields about which they write, and each article is intended to present an authoritative picture of recent progress. Each chapter is well provided with references to original papers. The volume maintains the high standard of its predecessors and is a valuable addition to the bookshelf of every worker in the field of hormones.

N. N. DE.

Elements of Electronics. By G. Windred. (Publishers: Chapman & Hall, Ltd., London), 1949. Pp. 198; 100 figures and 6 plates. Price 15 sh. net.

This book seeks to portray the growth of the science of electronics in all its bearings on various human activities. The treatment is non-mathematical though semi-popular.

The first four chapters of the book give a historical account of the discovery, the methods of production and the conduction in gases of electrons. The properties and general characteristics of photo-electric, photo-conductive and photo-voltaic cells and of thermionic valves are briefly dealt with in the next two chapters.

The seventh chapter describes the performances of the magnetron, the klystron and the cavity resonator in addition to those of the triode as amplifiers and oscillators within the compass of its 24 pages, while the succeeding chapter is devoted to the study of gas-filled valves as power rectifiers.

The X-ray tube and its medical and industrial applications, the cathode-ray tube and its use in the measurement of physical quantities as also in television systems and the role played by the photo-electric cell and the electronic amplifier in the sound film industry are covered in Chapters IX to XII. The principles of electron-optics and their utilisation in the design of the electron microscope and the principles of the cyclotron and the betatron together with their medical and research applications are dealt with in the next two chapters. The book concludes with the fifteenth chapter on "Radio-Location" which attempts an elucidation of the frequency modulated and amplitude modulated pulse methods as applied to the Plan Position Indicator and the Radio Altimeter within 11 pages including 7 figures. An index of a little over 2 pages is added.

In a book that strives to familiarise the reader with the working of such modern devices as the cyclotron or the betatron, it is somewhat strange to find the author fight shy of the word 'neutron' as he does when he describes the nuclei of helium and lithium atoms as containing 2 and 3 protons (p. 34) and stops there. It is perhaps the same conservatism that makes him prefer 4.770×10^{-10} e.s.u. (pp. 31 and 32) as the final corrected value of the electronic charge to the now universally accepted 4.8025×10^{-10} e.s.u. Readers are also apt to be misled by the table on p. 69 which lists the resistivity of selenium in ohms per "cm. cube" and its density also in grams per "cm.-cube". It is better to express in this context, density as gm. per "cubic cm.", even if usage sanctions ohms per "cm. cube" for resistivity though one would prefer ohm. cm. in the interests of accurate terminology.

The few misprints such as 'Kystroñ' on p. viii, 'V₂' for 'V₁' on p. 119, line 7, the omission of a connecting line in Fig. 65 on p. 128, etc., would probably not have crept in but for the untimely death of the author during the proof-reading stage.

It is seen from the enumeration of the contents that the work is a masterpiece of condensed treatment of the multitudinous applications of the electronic art. It should exercise its greatest appeal to the educated reader, who

without being a radio physicist, engineer or technician is yet interested in a semi-technical account of the intriguing subject of electronics.

R. L. N.

Faraday's Discovery of Electromagnetic Induction. By Thomas Martin (Edward Arnold & Co., London), 1949. Pp. 160. Price 9 sh. net.

Professor Martin has indeed made admirable use of the material contained in *Faraday's Diary*, and given us a very well-written and thoroughly enjoyable monograph on Faraday's discovery of electromagnetic induction. The monograph, we are sure, would appeal to a much wider class of readers than to students of the history of science, to whom it would of course be especially welcome.

The six chapters comprising the book deal with the subject in the manner of a well-planned series of popular evening lectures, but with a thoroughness and clarity and richness of detail (provided by many diagrams and illustrations from Faraday's own pen) not to be had otherwise. The introductory chapter, the hardest one to write about really, has been very ably done, and makes us see at once that the author of the great discovery was himself no ordinary person; it supplies besides the scientific background against which alone any fair estimate of Faraday's genius can be made. Chapter two deals with the preparation which must necessarily precede every great discovery.

Chapter three gives us a succinct account of the great discovery itself, mostly in Faraday's own words, adding richly to the human interest. Chapters four to six describe some more of Faraday's researches in the field, and are most admirably suited to drive home the lesson that Faraday was far too much of a pure scientist to allow himself to be sidetracked by the enormous practical possibilities of his discovery. As is only well known, the practical applications thereof, of which there are legion today, followed only much later.

This is just the kind of book which, in the opinion of the reviewer, can be prescribed as nondetailed study to every science undergraduate in our Universities. May we also express the hope that many more monographs of this kind, dealing with equally significant discoveries in other branches of science, would soon follow by way of familiarising the younger generation with what is at once beautiful and sublime in the field of scientific research?

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Artificial Radioactivity. By P. B. Moon, F.R.S. (Cambridge University Press), 1949. Pp. 109. Cloth Bound, Price: sh. 12/16. Agents: Macmillan.

This book is one of the series of Cambridge monographs on physics the major aim of the series being the presentation of the results on recent research in the entire field of pure physics. It contains 102 pages divided into four chapters. The treatment of natural radioactivity is excluded. With three or four exceptions, such as the very long-lived β -active K^{40} the naturally occurring isotopes of elements below $Z=81$ are all stable, but there are often vacancies among the existing isotopes of any one element. For example Cu^{63} and Cu^{65} are found but not Cu^{64} . This book is concerned with the nuclei that fill such gaps and particularly with their modes of spontaneous transformation. Because these nuclei are unstable and are not replaced in nature by the disintegration of long lived ancestors, they do not exist naturally and must be made from stable nuclei by nuclear reactions. The division of chapters is based according to the three classes of nuclear processes: those in which the nuclear charge Z changes by one unit in either direction, a nuclear proton transforming to a neutron or *vice versa*; those in which the nucleus loses energy without changing its charge; and secondary processes external to the nuclei in question. This is a valuable book. One regrets the method of citation used in the book, namely of quoting the references but omitting the year of publication.

B. DASANNACHARYA.

Investigations of the Band Spectrum of Beryllium Oxide. By Albin Lagerqvist. (Uppsala: Almqvist & Wiksells Boktryckerei AB), 1948. Pp. 98.

This is an inaugural dissertation for the Ph.D. Degree of the Stockholm University and forms a thorough investigation of the rotation structure of the BeO bands. The region from 2000 Å to 12000 Å has been investigated with a 21 ft. Wood's grating giving a dispersion of 1.2 Å per mm. More than 20000 rotation lines belonging to the $\Sigma^+ - \Sigma$, and $\Pi - \Sigma$, and $\Sigma^+ - \Pi$ systems have been measured and more than half of these have been arranged in series. Perturbations have been located in a large number of bands and are discussed in detail. The name of Prof. Erik Hulthén under whose guidance the work has been carried out is sufficient to indicate the reliability, thoroughness and utility of the investigation. The dissertation

will be a useful addition to the library of any institution teaching physics beyond a degree standard.
T. S. S.

The Power and Limits of Science: A Philosophical Study. By E. F. Caldin. (London: Chapman & Hall), 1949. Pp. x + 196. Price 12 sh. 6 d. net.

Here we have a timely and much needed study of the scope and limitations of scientific method by a Lecturer in Chemistry who has deeply studied the philosophical implications of the path actually pursued by scientists in wrestling the secrets of Nature. He has analysed the methods followed in Physics and Chemistry and comes to the conclusion that in striving towards quantitative laws Science has developed methods inapplicable to qualitative aspects of life, particularly to our ideas of duty, pleasure, beauty, happiness and so on. He has ably controverted the ideas of eminent authors of popular science like Eddington and Jeans and shows that the regularities observed in Nature are not entirely of our making and that God does not manifest himself as a mathematician. He also points out convincingly that physical principles like Heisenberg's uncertainty principle can have no bearing on questions of predestination and Free Will since the method followed in Science is not designed to study such problems. He also asserts that even the new psychology cannot have any bearing on the problem of human values and trusts that metaphysics and religion will always be the only guides for human behaviour. The arguments for this view are ably set out and are almost convincing.

But the present writer has a lurking feeling that prophesying regarding the future conquests of science is not likely to be a safe guide to our conduct. Just as the idea of colour was not susceptible of quantitative treatment before the advent of the wave theory of light, it might be that many aspects of life which now appear purely qualitative may prove themselves suited to a quantitative treatment. Also psychology, anthropology and comparative religion might profoundly modify what we now take as *a priori* truths in philosophy. In any case the studies of philosophers and scientists have to converge if either can be of service to the other, and students of both will be highly benefited by perusing such a well thought out examination of the scope and limitations of scientific method as is contained in the book before us.

T. S. S.

Practical Spectroscopy. By C. Candler. (Hilger & Watts Ltd., London), 1949. Pp. viii + 190 + 4 Plates. Price 21/- net.

This is a Hilger publication intended to meet the requirements of students of spectroscopy. The nine chapters include measurements of wavelength, qualitative and quantitative spectro-chemical analysis, absorption spectra, infrared spectra, Raman spectra, ultra-violet monochromator, structure of line spectra and interferometers. As indicated by the title the treatment is essentially practical with special reference to Hilger wave-length spectrometer. Each chapter however contains sufficient theory to render the experiments described intelligible. The best chapters are the first three dealing with the setting of the spectrometer and employment of the same for spectro-chemical analysis. Some more details in the methods of procedure seem to be necessary for a beginner at least for the measurement of extinction coefficients and for work, say, on Raman spectra of solids and powders. A special feature is the provision of a number of diagrams illustrating the applications of spectroscopy in various fields of research. In the chapter on Interferometer a conspicuous omission is Michelson's interferometer. The book is a good introduction to the study of practical spectroscopy, and for advanced study or research, the references at the end of each chapter should prove most useful.

M. R. N.

The Soils of Palestine. By A. Reifenberg (Thomas Murby & Co., M[s. George Allen & Unwin Ltd., Ruskin House, 40 Museum St., London W.C. 1). 1947. Pp. 179. Price 16 sh.

For fifteen hundred years, because of erosion, the burning of dung and the destruction of ancient irrigation systems, the land "wherein thou shalt eat bread without scarceness, thou shalt not lack anything of it" has steadily deteriorated. The causes leading to this deterioration and the efforts made by the Jewish immigrant community to restore once again the land to its original fertility so that it may support a big population in happiness and at a high standard of living are discussed in this most readable book. The author who is a lecturer at the Hebrew University of Jerusalem has played no small part in this great task of rehabilitation of the soil.

The book opens with an introduction in which the geology and relief, moisture conditions and climate of Palestine are briefly dealt with. The next chapter deals with soil formation in Palestine, in a detailed manner. The weathering process and particularly the role of colloidal silicic acid in soil

formation are discussed very impressively and the soils that occur in the arid, semi-arid, semi-humid and humid regions of Palestine are described very clearly. The formation of and theories on the evolution of 'Tena Rossa' are discussed and a very fine explanation involving the protective action of humours and colloidal silica on sesquioxide soils is put forward. This delineation leads on logically to the next chapter wherein soil formation under the Mediterranean climate as compared that under other climates, as caused by the influence of the climate and of the parent material the composition of the clay fraction and base exchange and H-ion concentration, is discussed. Under Soils as related to agriculture, the main emphasis is on citrus growing soils and the effect of the composition of the irrigation water and drainage. Very often, this important question of proper drainage is neglected or lost sight of in our country in irrigation projects and the attendant evils of waterlogging and poor yields from land in spite of irrigation is further emphasized by a study of this chapter.

After dealing briefly with manuring of citrus groves and soil erosion caused mainly by indiscriminate grazing and deforestation and wrong management, the great Zionist colonization in Palestine is dealt with and the book ends up with a very interesting description of the Jordan Valley authority. Given time and favourable conditions, the Palestine soils, if managed in the way described by the author, are capable of supporting the large population of the new Jewish State. Important references are given at the end of each chapter. This book will be of great interest not only to the soil scientists but also to all those who are engaged on similar problems of reclamation of deteriorated lands required to settle the many displaced persons and those engaged in improving the agriculture of tropical and sub-tropical areas.

N. G. C.

Vitamin E. By K. E. Mason and 115 others. Editor: Roy Waldo Miner. *Annals of the New York Academy of Sciences*, Vol. 52, Art. 3. (Published by the Academy, New York), October 1949. Pp. 63-428. Price 4.50 \$.

Vitamin E is unique in being the only vitamin to have commanded the attention of two international conventions, the one in London in 1939 and the other in New York in 1949. It is a happy coincidence that on the 25th anniversary of the christening of vitamin E by Surr, the New York Academy of Sciences have brought out this valuable monograph embodying the latest advances in the subject. Prior to 1939, information regarding this vitamin was some-

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what scanty. The symposium organised by Sir Jack Drummond and Mr. A. L. Bacharach in 1939 under the auspices of the Nutrition Panel of the Society of Chemical Industry helped to crystallise the then existing state of knowledge and indicated the possible lines of further investigations. Between then and now, a vast amount of literature has accumulated, not only regarding the functions and utility of this vitamin but also regarding its inter relationship with other vitamins and hormones in helping to promote the overall picture designated as optimum health. The fact that 116 authors, including names to conjure with in the field of vitamin E, figure in the monograph lends weight to the proceedings. The critical discussion that follows most papers is often extremely helpful in gaining a more intimate knowledge of the subject. The 67 papers contributed to the Conference have been divided into the following five sections: Morphological lesions in vitamin E deficiency; Tocopherols and their esters in enzyme and tissue functions; Protective action of vitamin E in conditions of metabolic stress; Practical nutrition aspects of vitamin E; and vitamin E in clinical medicine. The papers read and discussed reveal the outstanding advances made recently in the field of vitamin E, particularly its role in cellular chemistry in the prevention of auto-oxidation of unsaturated fats, and in clinical medicine. In spite of the many advances in our knowledge, there is, as aptly described by Pappenheimer, "a distressing lack of precise information as to the role of vitamin E in human nutrition".

Research workers in the field of vitamin E will be profoundly grateful to the New York Academy of Sciences not only for sponsoring the Conference on vitamin E but also for this admirable publication embodying the contributions and the discussions that ensued. The inclusion of a Subject and Author Index would have greatly enhanced the usefulness of the publication.

S. RANGANATHAN.

Canning Practice and Control. By Osman Jones. (Chapman & Hall Ltd., London), 1949. Third Edition. Pp. xvi + 322. Price. 36 sh. net.

The third edition of this well-known work makes its appearance some 8 years after its predecessor, with Mr. T. W. Jones as joint author. This interval has witnessed significant developments both in the theory and practice of canning and has therefore necessitated substantial revision in the presentation of the subject matter.

Designed primarily for use by the practical canner, the book presents the reader with a

selected body of factual and theoretical material. The general plan of the work remains as before. The manufacture of tin plate and the causes for corrosion and discoloration are now given in some detail. The analytical and microbiological sections outline revised methods for sampling and examination. Cultural notes on principal food spoilage organisms are augmented and new culture media included. Practically every chapter has a useful, though limited bibliography, and there are many well-titled photographs of plant and equipment together with photomicrographs of certain spoilage organisms, all on art paper inserted at intervals.

The author has achieved a great measure of success in his selection of material which is backed by personal experience and aims to be of direct service to the canner rather than to serve as a treatise. Even attention is given to plant operations as to process controls, but it is more in respect of the latter that the book is of value to the cannery foreman, chemist and manager alike. Probably because a review on the nutritive value of canned foods is a little out of place with the theme of this book, there is evidence of a lack of care in bringing the material here up to date; there are no references to work later than 1936. That canned foods could be more nutritious than fresh foods seems an overstatement, and it is unfortunate that the growing volume of recent work in this field has been ignored; noteworthy among these has been the large-scale survey, begun in 1942, under the joint auspices of the National Canners Association and the Can Manufacturers Institute in the U.S., since published in many technical journals. The methods listed for vitamin assays are neither sufficient nor among the 'newest', and they need therefore to be rewritten in the light of present-day developments in procedure.

There are quite a few errors which, happily, are only minor misprints. The book would undoubtedly recommend itself to the practical canner—for whom it will be invaluable—as well as to everyone interested in the development and practice of the science of canning. It should deserve the success of its previous editions.

A. SREENIVASAN.

Farming for Industry. By R. O. Whyte. (Todd Publishnig Group Ltd., London W. 1), 1948. Pp. 160. Price 7 sh. 6d.

This delightfully readable little volume represents a successful attempt at presenting a "panoramic picture of farming for industry". As the author himself has confessed the subject matter covered by the book is so wide that each chapter deserves a book in itself. As an intro-

duction to this important subject, however, there are few which can excel this book.

In the course of nine chapters which comprises the volume, the author has entered a strong plea for a more efficient agronomical organisation for the production of technical crops in higher yields and at cheaper costs. In view of the ever-increasing pressure on land, it is imperative that a more intensive cultivation of Farm Crops should be carried out and that the bye-products, now running to waste, should be fully utilised for the production of chemicals and other useful products.

The author has chosen either to ignore or to make only a passing mention of many of the industrial products derived from plantation crops or forest trees. We earnestly hope that the author will soon present his numerous readers a companion volume which would include these equally important products, viz., lac, plantation rubber, tea, coffee, cocoa, essential oil like sandalwood oil, drugs, etc.

A Bibliography of Dyeing and Printing. By L. G. Lawrie. (Chapman & Hall, London), 1949. Pp. 143. 15 sh. net.

The art of dyeing and printing of textiles was no doubt known to the ancient world; but unfortunately, the only records of such knowledge are a few archaeological specimens.

The author of the book under review has attempted to present most of the available information on dyeing and printing from the fifteenth century onwards.

In the first part, a complete list of books and pamphlets connected with the tinctorial art has been presented in an alphabetical order of the authors. In all, 816 works are mentioned. In the second part, the same information is presented in chronological order, and in the third, a classified index is given.

It is extremely interesting to note that the rapid increase in the number of books on the subject is closely linked with that period in which the coal tar dyestuff industry rapidly progressed. Since then, the rate of publication of new books appears to have remained approximately the same.

Apart from a few minor misprints such as "dies" for "dyes" on page 137, line 15, the book is well printed and contains a large amount of information relating to the historical development of the art of dyeing and printing. It is felt that the book will be of considerable interest to those engaged in the study and practice of the dyeing and the printing industries.

G. M. NABAR.

The Human Body and its Functions: An Elementary Textbook of Physiology. By C. H. Best and N. B. Taylor. (Revised Edition), 1949. (Chapman & Hall, London.) Pp. xi + 1-500. Price 18 sh. net.

The revised edition of this well-known work, first published in 1932, is practically a new book because it has been largely rewritten and much new material added. Rapid advances have taken place in the field of human physiology during the past two decades and their impact on modern life has created a great deal of popular interest; words like calories, vitamins, deficiency diseases, endocrines etc., appear almost every day in print and there are not many reliable publications which the non-technical reader could consult with advantage. Unlike the *Living Body* by the same authors, addressed to the serious student, this book is intended for the layman; the treatment, language and illustrations are all designed to meet this objective.

The material is arranged in ten parts, beginning with general principles dealt with in the first two chapters, giving an admirably clear exposition of the fundamental principles and the physico-chemical background of physiological studies. The blood and tissue fluids, circulation of blood, physiology of breathing, digestion, nutrition, nervous system, sense organs, endocrine glands, reproduction, sex and heredity are dealt with in the forty-four chapters that follow, covering the usual ground of a course in physiology. The descriptive accounts are lucid and well illustrated with simple drawings (which are independently numbered with reference to each chapter) and a set of eight coloured plates. The emphasis on the physiological aspect has been kept right through the work without bringing in too many anatomical details. The information presented is in most respects up to date taking into account the recent progress in each branch of study. Technical terms are only sparingly introduced into the narrative and adequately explained. Topics of general interest like vitamins and heredity have received special attention. While the general reader will find much information to interest him and satisfy his curiosity, the more specialized reader will discover in the work original methods of treatment in subjects like the working of the internal ear and the conduction of nerve impulses. A most welcome feature is a pronouncing glossary for technical terms. All these should certainly contribute to make this work deservedly popular.

N. K. P.

A Chemistry of Plastics and High Polymers.
By Dr. P. D. Ritchie. (Cleaver-Hume Press Ltd., London), 1949. Pp. viii + 288. Price 25 sh.

All those interested in the rapidly developing field of high polymers will welcome the publication of this book. Dr. Ritchie's book, based primarily on his teaching experience, constitutes a concise but fairly comprehensive, informative and up-to-date discussion of the chemistry of high polymers. It is particularly useful to students and those who want a quick but fair review of the subject.

The first three chapters pertain to the basic concept and kinetics of polymerisation and are followed by a chapter on the chemistry of different polymeric materials. The subsequent three chapters provide a fair discussion of the important polycondensates. The next five chapters are devoted to natural polymers, which is an important feature of the book. A brief mention is also made of the chemistry of drying oils and silicones in the subsequent chapters.

The author has indicated that the book is written primarily for organic chemists but the inclusion of the manufacture, properties and applications of different polymeric materials would have been quite appropriate. The chapter on physical properties besides being limited has a very incoherent discussion. In spite of the limited scope of the book as pointed out by the author, this single chapter should have been elaborated since the significance and clear understanding of the nature of macromolecules is best elucidated by a study of their physical behaviour on which is based most of the present development. The inclusion of references to original literature would have been also useful.

In spite of these shortcomings the book will find immense favour with students and qualified chemists who want to acquaint themselves with the subject. The book is well written and well produced.

S. L. KAPUR.

SCIENCE NOTES AND NEWS

A New Einstein Theory?

In a new edition of his famous work *The Meaning of Relativity*, to be published next month by the Princeton University Press, Einstein will set forth what some of his friends say is the long-sought unified field theory. The scientist himself has given no public hint of any such extraordinary development, but he is said to have told close associates at the Institute for Advanced Study that he regards the new theory as his greatest achievement. He is reported to have given enthusiastic blackboard explanations of his equations, switching from English to German and back again in his excitement, to spellbound groups of his colleagues at recent informal conferences at the Institute.

Einstein's paper explaining his new work will appear as a modest 16-page appendix to his republished book. If it is indeed a statement of a unified field theory, and if it can be confirmed by other workers, it will be the most important event in theoretical physics in many years.

International Meetings on Shellac and Mica

The meetings of the two International Committees on Shellac and Mica of the International Organisation for Standardisation called in New Delhi by the Indian Standards Institution

(ISI) arrived at substantial agreement concerning standards of these commodities on the international plane.

At these meetings, the countries represented included U.S.A., U.K., France, Belgium, Netherlands, Finland, Switzerland, Portugal and India. The International Organisation for Standardisation (ISO) was also represented by Mr. Henry St. Leger, the General Secretary.

The Shellac Committee, which met under the Chairmanship of Sardar Datar Singh, formulated international draft recommendations for standardisation on three commercial varieties of Lac, namely, Seedlac, Shellac and Bleached Lac. Besides specifying the quality standards of the various grades of each product, the international specifications deal with standard methods of test for each physical and chemical characteristic which the various grades are expected to satisfy.

The Mica Committee, which met under the Chairmanship of Shri Chandmull Rajgharia, arrived at substantial agreement on standards concerning grading and classification of Mica. Grading in the Mica trade concerns the sorting of Mica pieces according to their size, while classification implies visual quality determination. All Mica is graded and classified according to methods accepted as standard in different parts of the world. This International Committee has now arrived at unification of these

methods applicable both to grading and classification.

While agreement has been reached on most of the points, a few differences still exist which have been referred to a Working Commission appointed by the International Committee. The Working Commission is expected to report its findings not later than the end of February 1950.

Insect-Proof Packing

The fight against food waste has been carried a stage further in Britain with the development of insect-proof wrappings, as a result of research carried out by the Pest Infestation Laboratory. Just the material needed for the wrappings was found in soft cellulose wadding commonly used for wrapping radio valves and other delicate objects. When several layers of this material impregnated with D.D.T. are used as wrappings, boring insects enter the deadly labyrinth where they wander about, until the insecticide kills them. A further advantage of this wrapping is that it need not be sealed. With food, however, the wrapping is enclosed between sheets of paper to prevent the D.D.T. causing contamination.

U.S. Scholarship for Indian Students

Messrs. Joseph E. Seagram & Sons, Louisville, Kentucky, U.S.A., have offered one scholarship to a student from India in their International Fellowship Programme beginning from September 1, 1950.

The scholarship runs for a period of one year from the date of arrival, during which time the scholar will receive a weekly subsis-

tence allowance of \$52.00. The student must pay for his transport to and from the U.S.A. The age of the candidates should preferably be 30 years or under.

Through this programme young scientists from all parts of the world are given an opportunity to study, observe and do research in the fields of industrial fermentation and distillation, that is, the production of power (ethyl) alcohol. Modern industrial methods, machinery and processes are studied in the Seagram plant at Louisville, Kentucky, under the guidance of competent instructors and research technicians. The applications on the prescribed form should be sent direct to the First Secretary, Embassy of India in the U.S.A., Education Department, 2107, Massachusetts Avenue, Washington, D.C., by March 15, 1950.

Full particulars of the award and copies of the application form have been circulated by the Ministry of Education, Government of India, to Vice-Chancellors of all Universities in India and various technical institutions. Intending candidates may obtain the same from the University or the institution concerned.

Entomological Society of India

Officers and Council for 1950:—President: Dr. H. S. Pruthi; *Vice-Presidents:* Dr. N. C. Chatterjee, Shri M. C. Cherian, Dr. E. S. Narayan, Dr. D. R. Mehta; *Chief Editor:* Shri Y. Ramachandra Rao; *Councillors:* Dr. D. D. Mukherjee, Mr. Ramachandran; *General Secretary:* Dr. S. Pradhan.

FORTHCOMING INTERNATIONAL CONFERENCES

Date	Subject	Organisers	Location
May 1-25, 1950 ..	U.N.E.S.C.O. General Conference (5th Session)	UNESCO	Florence
June 1950 ..	Physics in Chemistry and in Industry	..	Berne
June 29-July 8 ..	High Tension Conference	International Conference on Large Electrical Systems (C.I.G.R.E.) Secretary, British National Committee, C.I.G.R.E., Thorncroft Manor, Dorking Road, Leatherhead Surrey	Paris
July 17-21 ..	16th International Conference of Ophthalmology	Royal College of Surgeons, Secretary, Frank W. Law, 45, Lincoln's Inn, W.C. 2	London
July 17-26 ..	International Meeting for Optical Science	Hon. Sec., Prof. L.C. Martin, Imperial College, Exhibition Road, S. W. 7	London
July 25-28 ..	International Anatomical Congress	Secretary, Miss A. M. Maynall, Dept. of Human Anatomy, Univ. Museum	Oxford

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.

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